School of Public Health

Prevalence of Suicide and Suicide Ideation in Western Australia Using Linked Data Sources

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature:

Date:

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Abstract

Suicide is recognised as a major health problem, accounting for more deaths in the world than wars and homicides combined. The prevalence of non-fatal suicide attempts is estimated to be more than 20 times greater than deaths to suicide, but few studies have assessed the proportion of suicide attempts that are admitted to hospital.

Respondents were 30,634 adults aged 16 years and over who completed the Western Australian Health and Wellbeing Surveillance System (HWSS) suicide module between March 2002 and June 2008. Their HWSS responses were linked to the Hospital Morbidity Database System (HMDS), the Emergency Department Data Collection (EDDC), the Mental Health Information System (MHIS), and the Mortality Database.

During the study period the prevalence of suicide ideation ranged from 3.3% to 5.1%, while the prevalence of suicide-related behaviour ranged from 0.3% to 0.8%. Neither suicide ideation nor suicide-related behaviour showed a significant change over time.

While there were several variables found to be associated with suicide ideation and suicided-related behaviour, the discriminative ability of the resulting models remained insufficient. Risk factors for both suicide ideation and suicide-related behaviour included: gender (being male for ideation, but female for suicide-related behaviour); being a young adult; and having a current mental health disorder.

One-quarter of respondents to the HWSS did not agree for their information to be linked with other data, creating the potential for a strong self selection bias. Only 9% of respondents who self-reported suicide-related behaviour in the last year had an intentional self-harm hospitalisation, highlighting the difference in using self-reported versus administrative data sets in suicide research.

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CHAPTER ONE
INTRODUCTION

1.1. Significance of suicide

Suicide, the deliberate taking of one's life (Australian Bureau of Statistics 2008b), is the cause of more deaths worldwide than wars and homicides combined (Bertolote et al. 2006; The International Association for Suicide Prevention 2003). In Australia it was the 15th leading cause of death in 2010, accounting for 2,361 deaths (Australian Bureau of Statistics 2012j). Suicide not only results in death, but can also have a deep effect on families and communities (Crosby, Cheltenham, & Sacks 1999) in terms of both human suffering and economic costs (Diekstra 1993; Meehan et al. 1992). Hence, suicide is a significant public health issue (Australian Bureau of Statistics 2008b).

Suicide exists on a spectrum (Gunnell et al. 2004; Crosby, Cheltenham, & Sacks 1999) that begins with fleeting suicide thoughts (ideation), proceeds to suicide attempts and ends with fatal suicide (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998). Hence an understanding of suicide ideation and attempts are integral to the understanding and prevention of suicide. Furthermore, suicide ideation and suicide attempts are themselves a public health issue as they suggest psychological suffering (Meehan et al. 1992) and are amenable to public health interventions.

It is difficult to determine the true prevalence of suicide attempts, with estimates ranging from 10 (Diekstra 1993) to 20 times higher than suicides (De Leo & Evans 2003; Gunnell 2000). Studies that draw information from administrative hospital records underestimate suicide attempts as they are restricted to only medically serious attempts. In contrast, while self-reported studies are not limited to medically serious attempts they may suffer from inaccuracies in recall and need to be collected.

1.2. Defining suicide attempts

The comparability of suicide research is limited by an inconsistency in the classification of suicide attempts (Nock & Kessler 2006). For this study O'Carroll et al's (1996) proposed suicide nomenclature will be used, where a *suicide attempt* refers to a "potentially self-injurious behaviour for which there is evidence (either explicit or implicit) that the person intended at some (nonzero) level to kill himself/herself" and does not necessarily result in injury (O'Carroll et al. 1996, 247). Acts where there is no information regarding the intent will be classified as *Suicide-Related Behaviour*, defined as "potentially self-injurious behaviour for which there is explicit or implicit evidence *either* that (a) the person intended at some (nonzero) level to kill himself/herself, *or* (b) the person wished to use the *appearance* of intending to kill himself/herself in order to attain some other end" (O'Carroll et al. 1996, 247).

1.3. Study Summary

The purpose of this study was to investigate suicide behaviour and its associated risk factors in Western Australian adults between March 2002 and June 2008. The information from this study will add to the understanding of suicide behaviour.

This study used data collected from 30,634 adults aged 16 years and over who responded to suicide questions in the Health and Wellbeing Surveillance System (HWSS) - a continuous data collection system developed to monitor the health and wellbeing of Western Australians. As the HWSS did not collect any information regarding intention to die, all responses to the question regarding "suicide attempts" in the last year will be classified as suicide-related behaviour. The HWSS information was also linked to the following Western Australian administrative health data sets: the Hospital Morbidity Database System (HMDS); the Emergency Data Collection (EDDC); the Mental Health Information System (MHIS); and the Mortality Database.

1.4. Aims and objectives of the study

The aim of this study was to investigate suicide behaviour and its associated risk factors in Western Australian adults and to determine the agreement between self-reported suicide-related behaviour and administrative health data sets.

This study was conducted in two parts:

Part A analysed the suicide information from the HWSS; and

Part B analysed the HWSS data that was linked to other administrative health data sets.

This study had six objectives;

1) to estimate the prevalence of suicide ideation and suicide-related behaviour among Western Australian adults;

2) to determine whether there was a change in the suicide ideation and suicide-related behaviour of the Western Australian adult population between 2002 and 2008;

3) to explore the associates of both suicide ideation and suicide-related behaviour among Western Australian adults;

4) to determine what proportion of self-reported suicide-related behaviour appear in administrative health data sets;

5) to determine what proportion of people engaging in suicide ideation and suicide-related behaviour subsequently died during the study period as a result of suicide; and

6) to determine what proportion of non suicide ideators subsequently died as a result of suicide during the study period;

1.5. Benefits of the study

Research into suicide behaviour is important as it enables the monitoring of psychological distress associated with suicide behaviour and contributes to the understanding of the factors associated with suicide behaviour, which may enable the prediction and prevention of deaths from suicide (Levinson et al. 2007).

As far as the author is aware this study was the first time the HWSS had been linked with administrative health data sets, such as the HMDS and EDDC, thus providing information on the proportion of respondents who were successfully linked.

It is estimated that between 10% to 30% of suicide-related behaviours are admitted to hospital (Meehan et al. 1992; Crosby, Cheltenham & Sacks 1999), but these estimates are obtained from self-reported information that has not been objectively validated. The linking of the HWSS with the HMDS will enable an objective estimate of the proportion of people who are admitted to hospital following a suicide-related behaviour. In addition, the linking of the HWSS to the EDDC will enable an objective estimate of the proportion of people who present to an emergency department following a suicide-related behaviour.

1.6. Definition of terms

Associate – A term used for a variable related to either an increased risk or a protective factor, regardless of whether or not there is a causal link.

EDDC - The Western Australian Emergency Department Data Collection, which contains information on patients presenting to emergency departments at public hospitals in Western Australia and is used as one of the linked data sources in this study.

HMDS - The Western Australian Hospital Morbidity Database System, which contains information on patients admitted to Western Australian hospitals and is used as one of the linked data sources in this study.

HWSS - The Western Australian Health and Wellbeing Surveillance System, which is a continuous population health survey used as the primary data source in this study.

MHIS - The Western Australian Mental Health Information System, which contains information on people using public mental health services in Western Australia and is used as one of the linked data sources in this study.

Suicide - The deliberate taking of one's life (Australian Bureau of Statistics 2008b). In Australia for a death to be classified as a suicide it must be recorded as being due to external causes and determined by a coronial enquiry to be a deliberate act intended to end one's life (Australian Bureau of Statistics 2005).

Suicide attempt - "potentially self-injurious behaviour for which there is evidence (either explicit or implicit) that the person intended at some (nonzero) level to kill himself/herself" and does not necessarily result in injury (O'Carroll et al. 1996, 247).

Suicide behaviour - The range of behaviours related to suicide, including suicide ideation, suicide gestures, suicide-related behaviour, suicide attempts and suicides.

Suicide gesture - "potentially self-injurious behaviour for which there is evidence (either explicit or implicit) that (a) the person did not intend to kill himself/herself (i.e., had zero intent to die), *and* (b) the person wished to use the *appearance* of intending to kill himself/herself in order to attain some other end (e.g., to seek help, to punish others, to receive attention)" (O'Carroll et al. 1996, 247).

Suicide ideation - “Self-reported thoughts of engaging in suicide-related behaviour” (O'Carroll et al. 1996, 247).

Suicide-related behaviour - “Potentially self-injurious behaviour for which there is explicit or implicit evidence *either* that (a) the person intended at some (nonzero) level to kill himself/herself, *or* (b) the person wished to use the *appearance* of intending to kill himself/herself in order to attain some other end” (O'Carroll et al. 1996, 247).

CHAPTER TWO

LITERATURE

2.1. Suicide

Suicide is a significant public health issue (Australian Bureau of Statistics 2008b), accounting for more deaths than wars and homicides combined around the world (Bertolote et al. 2006; The International Association for Suicide Prevention 2003). Therefore, it is essential to not only have an understanding of the prevalence of suicide, but also of the risk factors that are associated with suicidal behaviour (Druss & Pincus 2000).

In most developed countries suicide is one of the leading causes of death, but it is an often neglected problem (Diekstra 1993). It is estimated that around the world one person dies as a result of suicide every 40 seconds, making it the 13th leading cause of death (The International Association for Suicide Prevention 2003; World Health Organization 2013) and the fifth leading cause of death among young people (Brezo, Paris, Barker, et al. 2007). The World Health Organisation (WHO) has estimated that around 1.53 million people will die from suicide in 2020, representing one death every 20 seconds (Bertolote & Fleischmann 2002).

Over the last 45 years suicide has increased by around 60% in some countries (World Health Organization 2013) and is now one of the top five causes of death worldwide (Bertolote et al. 2005). In 2002 there were an estimated 877,000 suicides worldwide, with self inflicted injuries accounting for 1.4% of the global burden of disease (WHO 2003). By 2020 the global burden is expected to have increased to 2.4% (Bertolote et al. 2005).

Suicide not only impacts the person involved, but can also have profound effects on families and communities (Crosby, Cheltenham & Sacks 1999), both in terms of human suffering and economic terms (Diekstra 1993; Meehan et al. 1992). The economic cost is estimated to be billions of dollars as it reflects the potential years of life lost as well as medical costs of attempts, and care and suffering of friends and family (International Association for Suicide Prevention 2007). In Australia alone, the economic cost of suicide and self-harm is estimated to be around 3 billion dollars (Crisis Support Services 2007). The grief associated with a suicide is often regarded as being different from any other death as it generally involves feelings of guilt and blame (The Senate Community Affairs References Committee 2010).

2.1.1. Factors influencing suicide rates

Suicide rates differ widely between countries (Schmidtke et al. 1999), with the highest suicide rates found in former Soviet countries for males (Schmidtke et al. 1999; Gunnell 2000; World Health Organization 2007) and in Sri Lanka for females (World Health Organization 2007). In both developing and developed countries there are many factors that may impact the reporting of suicide, including legal issues, cultural or religious attitudes towards suicide (Mathers et al. 2005; Moscicki 1995), the quality of suicide data and the commonly used suicide method (Gunnell 2000; Wilkinson & Gunnell 2000). Psycho-social factors related to suicide, such as socio-economic status and unemployment, are often found in countries with high suicide rates (Goldney 2003).

Bertolote and Fleischmann (2002) reported a relationship between the suicide rate and religion of the country. In Muslim countries, where suicide is strictly forbidden, a suicide rate of close to zero was found. In contrast, the suicide rate in Hindu and Christian countries was around 10 per 100,000, in Buddhist countries 17.9 and in atheist countries, such as China, around 25.6 per 100,000 population (Bertolote & Fleischmann 2002).

Irrespective of the societal factors that impact the reporting of suicide, Goldney (2003) believes that all countries would have a base suicide rate of around 5 to 10 suicides per 100,000 population per year. Goldney (2003) asserts that countries with very low suicide rates reflect inaccuracies in the reporting of suicide, while countries with high suicide rates reflect an influence of psycho-social factors. For example, Phillips, Li and Zhang (2002) hypothesise that because there are no legal or strong religious restrictions regarding suicide in China it might be viewed as an acceptable option for people with chronic life stressors or serious mental disorders, thus explaining the high suicide rate in China.

With the exception of only a handful of countries, including China, suicide rates are higher in males than females (Bertolote & Fleischmann 2002). In China the high rate of suicide in young rural women accounts for much of this sex difference, making it unique from the other countries where females have a higher suicide rate than males (Phillips, Li & Zhang 2002).

In terms of absolute numbers, there are 30% more suicides in China than in Europe (Bertolote & Fleischmann 2002) due to the population size. Suicide rates in developed countries tend to increase with age, with the highest suicide rate found in people aged 65 years and over (Moscicki 1995; International Association for Suicide Prevention 2007). However, in terms of numbers of deaths, more young people die as a result of suicide as the older age group are more likely to die from chronic conditions and infectious diseases (Moscicki 1995; Bertolote & Fleischmann 2002). Given the correlation between age and suicide, there will be an increase in the national suicide rates as life expectancy increases and the population 'greys' (Bertolote & Fleischmann 2002; Diekstra 1993).

2.1.2. Suicide in Australia

In Australia suicides must be both recorded as being due to external causes and determined by a coronial inquiry to be a deliberate act intended to end one's life, and so they are likely to be underreported (Australian Bureau of Statistics 2005). In 2006 the

Australian age-standardised suicide rate was 13.6 per 100,000 for males and 3.8 per 100,000 for females (Australian Bureau of Statistics 2008b). In 2006 there were 1,799 suicides, accounting for 1.4% of all deaths and making it the 15th leading cause of death (Australian Bureau of Statistics 2008b). In 2010 suicide remained ranked as the 15th leading cause of all deaths in Australia (Australian Bureau of Statistics 2012j). The suicide rate is higher in younger people (Australian Bureau of Statistics 2007d) and is one of the major contributors to Years of Potential Life Lost (YPLL), particularly for males (Australian Institute of Health & Welfare 2006).

The age-standardised suicide death rate decreased from 14.7 per 100,000 in 1997 to 8.6 per 100,000 in 2006, while the male age-standardised suicide death rate has remained around four times higher than that of females (Australian Bureau of Statistics 2008b). During this period the method of suicide has also changed, with firearms decreasing from 12.1% in 1997 to 8.6% in 2006 and hanging increasing from 36.3% in 1997 to 52.0% in 2006 (Goldney 2006; Australian Bureau of Statistics 2008b). As Goldney (2006) points out, this change in method is particularly concerning given the difficulty of legislating against hanging.

Suicide rates for males aged 15-24 years quadrupled between 1960 and 1994 in Australia, from 6.8 to 26.8 per 100,000, while the rates for females doubled from 2.0 to 4.3 per 100,000 (Cantor & Baume 1999). At least part of this increase in the suicide rate is attributed to an increase in access to certain methods of suicide (Cantor & Baume 1998). The popularity of suicide methods differs both over time and between countries, and is influenced by a complex combination of factors (Cantor & Baume 1998).

In Australia the suicide rate differs with Aboriginal and Torres Strait Islander (ATSI) status. Among males the suicide rate of ATSI people was almost three times that of non-ATSI people during 2001 to 2005 (Australian Bureau of Statistics 2008d). The greatest disparity occurred in the 25 to 34 year age group, where the suicide rate was four times higher in ATSI males (Australian Bureau of Statistics 2008d). In contrast, ATSI female suicide rates are more similar to non-ATSI rates than males, with the age-specific rate of

45 year olds and over similar to or lower than non-ATSI females (Australian Bureau of Statistics 2008d). The median age at death as a result of external causes, which includes suicides, is considerably lower for ATSI people compared with non-Indigenous (31.3 years compared with 52.1 years) (Australian Bureau of Statistics 2008b).

There are geographic differences in suicide as well, with higher suicide rates in rural compared with urban areas (Australian Bureau of Statistics 2007d). Wilkinson and Gunnell (2000) analysed Australia suicide rates from 1988 to 1997 and found that the highest suicide rates were found in non-metropolitan males. This higher suicide rate in rural areas has also been found in more recent years, with a higher suicide rate found for men in all ages, particularly among 20 to 29 year olds (Caldwell, Jorm & Dear 2004). Among women, only the suicide rate in 30 to 44 year olds was found to be higher in rural compared with metropolitan areas (Caldwell, Jorm & Dear 2004).

Between 2005 and 2009 WA had the fourth highest age standardised suicide rate, behind the Northern Territory, Tasmania and South Australia (Australian Bureau of Statistics 2011). This order was similar for both males and females with WA males more than three times as likely as females to die by suicide (18.5 per 100,000 compared with 5.2 per 100,000) (Australian Bureau of Statistics 2011).

In 2010 the Australian Senate released a report *The Hidden Toll: Suicide in Australia* to raise awareness about the extent of suicide in Australia and to outline the Government's recommendations for suicide prevention in Australia (The Senate Community Affairs References Committee 2010). One of the report's recommendations was to improve the accuracy of suicide reporting and statistics.

2.1.3. Data Quality

Information regarding cause of death is coded using the International Statistical Classification of Diseases and Related Health Problems (ICD), which enables

comparability across countries. However, there are differences in the way in which cause of death is determined (Mathers et al. 2005). For example, while in most developed countries a medical practitioner certifies the cause of death, in developing countries deaths may be registered without a medical opinion (Mathers et al. 2005).

In a review of death registration data supplied to the WHO, Mathers et al. (2005) concluded that only 56% of the 115 countries reporting data were considered to be 100% complete (covering all geographic areas and including all members of the population), with the majority of these being developed countries. Of the 106 Member States reporting data on death registrations since 1990 with at least 50% completeness, or coverage, only 22% were regarded as having high-quality data (completeness of at least 90% and less than 10% use ill-defined codes) (Mathers et al. 2005). Australia is one of these Member states reporting high quality data.

Even in countries where medically trained staff assign cause of death, there is often an overuse of unknown and ill-defined cause categories (Mathers et al. 2005). In their comparison of WHO death data, Mathers et al. (2005) found that the proportion of deaths coded as ill-defined causes varied from 4% in Zealand to more than 40% in Thailand and Sri Lanka. These ill-defined categories include deaths from injuries where the intent was not determined, so some of these deaths may have been suicides.

Suicides may be misclassified as a result of legal, cultural and religious factors, or due to ambiguous circumstances, such as single car crashes (Denning, Yeates Conwell & Cox 2000). For example, in the UK the influence of alcohol has resulted in intentional hangings being classified as narrative findings rather than as suicides (Savill 2008).

When referring to suicide data, sensitivity refers to the accuracy of the identification of suicides, while specificity refers to the correct identification of non-suicides (Rockett & Thomas 1999). Researchers generally assume a specificity of 100% in suicide, emphasising the undercounting and ignoring the potential for over-counting (Rockett & Thomas 1999). Rockett and Thomas (1999) assessed the sensitivity of suicide

information in high income countries, using WHO information. They found misclassification of suicide occurs most often by suicides being classified under alternative injury mortality categories of unintentional drowning (E910), unintentional poisoning (E850-69) and undetermined injury intent (E980-E989). By assuming that all fatalities categorised in one of the three alternative injury mortality categories were misclassified suicides, the sensitivity of Australia's suicide information from 1988-1990 was estimated to be 80.8% for males and 76.1% for females, making it one of the highest. Rockett and Thomas (1999) concluded that suicide information from high income countries are spatially reliable enough for use in comparisons.

2.1.3.1. Data Quality in Australia

Even though Australia is regarded as having high quality death registration information (Mathers et al. 2005) there are still data quality issues. In Australia there are eight different registration systems that are responsible for the collection of death information (Australian Bureau of Statistics 2007b). While each of these jurisdictions is similar, there are differences in the coding and quality assurance practices (Australian Bureau of Statistics 2007b). The accuracy problems in regards to the cause of death information arise from errors in the collecting, recording and processing of the data, including misreporting of items, incomplete coverage, non-response to specific questions and processing errors (Australian Bureau of Statistics 2007b). The information used for a death registration is provided by a third party, whose responses to questions such as ATSI status may differ from what would have been self-reported (Australian Bureau of Statistics 2007b).

Deaths from external causes are coded according to both the intent of death (e.g. suicide) and the mechanism of death (e.g. poisoning) (Australian Bureau of Statistics 2007b). In Australia there is no standardised practice to determine the intent of a death during the coronial process. Coroners may be reluctant to make a finding of suicide for a variety of reasons including regulative barriers and sensitivity to religious beliefs of a family, and in some cases no statement of intent is made (Australian Bureau of Statistics 2007b). In

some cases, such as in single car crashes, the information required to determine a death as a suicide may make such a finding less likely (Australian Bureau of Statistics 2007b).

In Australia cause of death information is released annually and so there is a compromise between the timeliness and accuracy of this information. Given the need for timely information, increases in the length of coronial inquiries can affect the data quality of the cause of death information, as an open case limits the information available for coding and may result in a less specific code (Australian Bureau of Statistics 2007b). This is of particular importance for suicides as a coronial inquiry generally needs to be completed for both the mechanism and intent of death to be determined, which enables a death to be classified as a suicide. Without this information the death must be classified as accidental or unintentional (Australian Bureau of Statistics 2007b).

In recent years there has been an increase in the proportion of coronial cases that are still open when the coding is finalised and so deaths have been coded as accidental that might have previously been coded as suicides (Australian Bureau of Statistics 2007b). Of note is the increase in the last few years of the number of deaths classified as accidental threats to breathing, accidental poisoning, a result of inanimate mechanical forces (e.g. firearms) and exposure to unspecified factor and an associated decrease in the number of cases classified as suicide (Australian Bureau of Statistics 2007b). Information from other organisations show a higher number of suicides, which will be a result of a number of reasons including the use of less stringent criteria and accessing coronial records later in time when the cases have been completed and the necessary information documented (Australian Bureau of Statistics 2007b).

As a result of Australia's Senate report into suicide the Australian Bureau of Statistics has introduced a revision process where coroner certified deaths registered from 2007 onwards will be revised according to additional coronial information as it becomes available (The Senate Community Affairs References Committee 2010). This change will increase the ability to identify suicides and will no longer restrict the classification

as being finalised 13 months after the reference period (The Senate Community Affairs References Committee 2010).

2.2. Definitions of Suicidal Behaviour

While suicide is consistently defined as the deliberate taking of one's life (Australian Bureau of Statistics 2008b), there is inconsistency in the classification of suicide attempts. Nock and Kessler (2006) have identified three different perspectives that are used in the classification of suicide attempts. The first perspective uses liberal criteria that takes no account of a person's intention to die and so includes all self-harm behaviour as suicide attempts. This perspective appears to be widely used in the suicide literature as there often appears to be no consideration of intention to die. The second perspective uses criteria that distinguishes between attempters with and without intent to die and is interested in only those behaviours that show an explicit intent to die. The third perspective believes that it is neither useful nor possible to distinguish intent to die and includes all self-harm behaviour in the classification of suicide attempts. This third perspective results in a similar classification of suicidal behaviour as the first, but involves a conscious decision not to distinguish intent to die. Given these different perspectives there is an ongoing debate about the role of intent in definitions of suicidal behaviour (Nock & Kessler 2006).

The WHO follows the third perspective, excluding intention to die from their definition (Nock & Kessler 2006, 396). The WHO uses the term of 'parasuicide', which is defined as "an act with nonfatal outcome, in which an individual deliberately initiates a nonhabitual behaviour that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognized therapeutic dosage, and which is aimed at realizing changes which the subject desired via the actual or expected physical consequences" (Platt et al. 1992 cited in Hjelmeland 1996a, 396). This definition includes acts of self-harm where there is no intention to die, but excludes acts such as repetitive self-cutting.

Several studies measuring intention to die have found significantly higher intent scores in people who subsequently committed suicide, than in those who did not (Harriss, Hawton & Zahl 2005; Kuo, Gallo & Tien 2001; Hjelmeland 1996b; Suominen, Isometsa, Ostamo, et al. 2004; Suokas et al. 2001), suggesting a need to distinguish intent to die. Furthermore, when Nock and Kessler (2006) reanalysed lifetime suicide attempt information they found that the inclusion of intent to die reduced the prevalence of lifetime suicide attempts from 4.6% to 2.7%, again supporting the notion that these are two different populations.

O'Carroll et al. (1996) have proposed a suicide nomenclature that incorporates intention to take one's life. In their classifications *intent* is used only in reference to the intention to take one's life and not as a cry for help. They have defined a *suicide attempt* as "potentially self-injurious behaviour for which there is evidence (either explicit or implicit) that the person intended at some (nonzero) level to kill himself/herself" and does not necessarily result in injury (O'Carroll et al. 1996, 247). Self-harming behaviour with no intention to die is classified as *Instrumental Suicide-Related Behaviour*, defined as "potentially self-injurious behaviour for which there is evidence (either explicit or implicit) that (a) the person did not intend to kill himself/herself (i.e., had zero intent to die), *and* (b) the person wished to use the *appearance* of intending to kill himself/herself in order to attain some other end (e.g., to seek help, to punish others, to receive attention)" (O'Carroll et al. 1996, 247). This behaviour is often referred to as a *suicide gesture* (Nock & Kessler 2006, 396). Acts where there is no information regarding the intent will be classified as *Suicide-Related Behaviour*, defined as "potentially self-injurious behaviour for which there is explicit or implicit evidence *either* that (a) the person intended at some (nonzero) level to kill himself/herself, *or* (b) the person wished to use the *appearance* of intending to kill himself/herself in order to attain some other end" (O'Carroll et al. 1996, 247). "Self-reported thoughts of engaging in suicide-related behaviour" are referred to as *Suicidal ideation* (O'Carroll et al. 1996, 247).

2.3. Intent

Nock and Kessler (2006) believe that failing to distinguish suicide attempters with an intention to die from those without can lead to an overestimation of the prevalence of suicide attempts and create difficulties in identifying risk factors for suicide (Nock & Kessler 2006). But many self-reported studies of suicide collect the suicide information as one component of a broader health survey (e.g. Kessler, Borges & Walters 1999; Druss & Pincus 2000) and so intent to die is often not explicitly assessed in studies of suicide attempts (Nock & Kessler 2006) or suicide ideation.

Intent to die may often be regarded as being implicit as many questions used to assess suicide attempts and ideation ask questions such as "have you ever seriously thought about committing suicide?" and "have you ever attempted suicide?" (Bertolote et al. 2005). Safer (1997) have suggested that high school students are able to distinguish deliberate self-harm acts from suicide attempts, but Nock and Kessler (2006) found that when asked "have you ever attempted suicide" 42% of those answering yes also indicated that they had no intention to die. Beautrais (2006) and Kessler (1999) found a similar result, with nearly half the sample of suicide attempters/gesturers reporting they had no intention to die.

Even when intent is collected it may not be accurate as some people may deny or exaggerate it. For example de Moore et al. (1994) found that patients claimed they had accidentally shot themselves while cleaning a gun, despite no cleaning paraphernalia being found. The reported intent may be influenced by shame reactions experienced as a result of both having made an attempt and having survived an attempt; which may be viewed by the individual as a double failure (Wiklander, Samuelsson & Asberg 2003). Hence objective indicators, such as a lack of cleaning equipment in the previous example and taking precautions against discovery, are generally preferred over self-reported information in the determination of intent (De Moore et al. 1994; Freedenthal 2007). This is the type of information captured by Beck's Suicide Intent Scale (SIS): a 15 item questionnaire that assesses the severity of suicidal intention (Harriss & Hawton

2005). The SIS has two sections, the first of which collects information about the circumstances of the suicidal act, including the preparation and implementation of the attempt, the setting and precautions against discovery (Brown et al. 2004; Harriss & Hawton 2005). The second section collects information about the person's feelings and thoughts at the time of the act, including expectations about the lethality of the chosen method and expectations about the possibility of rescue (Brown et al. 2004; Harriss & Hawton 2005). The expectation rather than the actual lethality of the method is regarded as a better indicator of intent (Brown et al. 2004).

What respondents classify as a suicide attempt or gesture may also differ between respondents and studies, and may deviate from an accepted definition. For example, Crosby et al. (1999) reported that nearly one-third of respondents who reported a suicide attempt in the past year used a firearm as the method, causing the authors to question the validity of these responses. There may be differences of opinion as to whether holding a firearm without firing it constitutes a suicide attempt. O'Carroll et al.'s (1999) terminology argues that a suicide attempt does not need to result in an injury. Circumstances such as these highlight the ability of one's intent to change within a short period of time, such as when aborting a suicide attempt (Freedenthal 2007), though one might argue that the act of aborting the attempt calls into question the intent to die.

There is conflicting evidence as to the association between intent and lethality. Some studies found high suicidal intent to be strongly associated with lethality of suicide related behaviour (Haw et al. 2003) and with a violent method choice (Harriss, Hawton & Zahl 2005). However, other studies have not found this association between intent and violent methods (Hjelmeland 1996b). In a study of suicide attempters, Brown et al.(2004) found there was no association between suicide attempter's expectation of lethality and the observed medical lethality. Given that over half the patients (52%) had an inaccurate expectation of the lethality of their method, neither method choice nor medical lethality (seriousness) of the attempt may be indicative of intent. Similarly, in a small clinical sample Watson et al. (2001) found no association between suicidal intent and the clinician's observed assessment of the potential lethality of the attempt.

2.4. Method

The popularity of suicide methods differs both over time and between countries and is influenced by a complex interplay of factors including the physical availability and social acceptability of a method (Cantor & Baume 1998). The lethality of any given method is effected by the time between the suicide event and death, as a longer time enables more opportunity to seek help or to be helped (McIntosh 1992 cited in Cantor & Baume 1998). Firearms have been found to be the most lethal method, followed by carbon monoxide and hanging (Cantor & Baume 1998).

Restrictions on methods of suicide can have different impacts as a result of the social, environmental and temporal influences. But while limiting access to methods may have the greatest potential for reducing deaths, it would be difficult to reduce hanging outside psychiatric and correctional institutions (Cantor & Baume 1998). As the availability of hanging has not changed over time, Cantor and Baume (1998) suggest that a change in acceptability must explain the increase in hanging as a suicide method found in Australia in recent years (Goldney 2006; Australian Bureau of Statistics 2008b). The reduction in firearm use could also be a result of the gun legislation changes that were introduced in Australia as a result of the 1996 Port Arthur massacre. The social acceptability of hanging and the somewhat contagious nature of suicide may be evidenced by the example of over 20 hanging suicides of young people in a small area of South Wales in the past 18 months (Sydney Morning Herald 2008).

There are gender differences in the methods used to commit suicide, with women tending to use less violent methods (Denning, Yeates Conwell & Cox 2000; Cantor & Baume 1998; Hawton 2000). In Australia, in 2010 females were twice as likely to suicide as a result of poisoning compared with males (35% compared with 18%) (Australian Bureau of Statistics 2012l). In contrast, males were four times more likely to suicide as a result of firearms compared with females (8% compared with 2%) (Australian Bureau of Statistics 2012l).

Several suggestions have been posited to explain this gender difference, including trying to minimise the trauma caused for the people who find their bodies, male familiarity with guns and violence through boyhood games and a neurobiological association of aggression (Denning, Yeates Conwell & Cox 2000). In a psychological autopsy study, Denning et al (2000) found that while men were more likely than women to choose a violent method there was no gender difference in suicidal intent, as measured by a modified version of the Suicide Intent Scale (SIS). Gender was a significant predictor of the violence of the method used (Denning, Yeates Conwell & Cox 2000); highlighting that method choice is not a proxy for intent.

2.5. Suicidal Behaviour

Research into suicide is important for the potential prediction and prevention of deaths as well as for monitoring the high distress level associated with suicidal behaviour (Levinson et al. 2007). Suicide exists along a continuum (Gunnell et al. 2004; Crosby, Cheltenham & Sacks 1999) that begins with fleeting suicide thoughts, proceeds to suicide attempts and ends with fatal suicide (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998) and so "preventing less serious events may preclude more life-threatening health problems" (Crosby, Cheltenham & Sacks 1999, 131).

As well as the problem of how suicide attempts are defined, suicide research has also suffered from a lack of comparisons between suicidal and non-suicidal participants, a limited number of longitudinal studies and a failure to take into account methodological issues regarding confounding, sample selection bias and measurement errors (Beautrais 2000). As with suicide, there may be differences in suicide attempts, gestures and suicide ideation between countries that limit the comparability of studies and the generalisation of results to other areas.

2.5.1. Prevalence of Suicide-related behaviour

Suicide-related behaviour is a serious problem as it reflects psychological suffering and desperation and suicide attempters are at high risk of subsequent fatal suicide (Meehan et al. 1992). In addition, people exhibiting suicide-related behaviour have a higher mortality compared with the general population both as a result of suicide and natural causes (Holley, Fick & Love 1998a; Lawrence et al. 2000; Lawrence et al. 2001; Ostamo & Lönnqvist 2001; Suominen, Isometsa, Ostamo, et al. 2004; Holley, Fick & Love 1998b).

There is debate in the literature as to whether suicide completers and suicide attempters are the same or two different populations (Beautrais 2001). Some of the reasons behind the suggestion they are two populations include the gender difference (males complete suicide more than females, but females attempt suicide more than males); age (suicide completers are older than attempters); lethality of method (suicide completers tend to use more lethal methods) and extent of impulsive suicidal behaviour (Beautrais 2001).

While it is known that the prevalence of non-fatal suicide attempts is much higher than suicides, it is difficult to estimate the prevalence of such acts. It is estimated that the prevalence of suicide attempts may be 10 (Diekstra 1993) to 20 times higher than suicides (Gunnell 2000; De Leo & Evans 2003). As it is estimated that only one in four people with self-reported suicide-related behaviour seek help from medical services (Diekstra 1993), studies that rely on administrative health records may greatly underestimate the extent of suicide attempts. Hence, much of the information regarding the prevalence of suicide attempts or suicide-related behaviour comes from health surveys.

The prevalence of suicide-related behaviour is generally reported either as a lifetime prevalence or as a period prevalence, generally relating to the previous 12 months (shown in Table 2.1). The majority of the health studies shown in Table 2.1 made no reference to intention to die and so have been classified as suicide-related behaviour to highlight this issue. Despite variations between studies the prevalence of suicide-related

behaviour in the last year has generally been found to be less than 1%, while the lifetime prevalence of suicide-related behaviour in the last year has varied between 0.4% and 10.4%.

The different methodologies used in these health surveys limit the comparability of the information collected. There are differences in the wording of questions used to collect suicide-related behaviour information from surveys. Some studies ask all respondents about suicide-related behaviour irrespective of whether they reported suicide ideation, while in other studies only respondents reporting suicide ideation are asked additional questions about attempts. While suicide ideation is a necessary precursor of suicide and suicide attempts (Goldney et al. 2000), Brezo et al. (2007) found that 2% reported suicide-related behaviour despite not reporting ideation.

Some of the research focuses on the younger population (e.g. Meehan et al. 1992; De Leo et al. 2005), which limits the comparability between studies. This exclusion of the older population, along with the use of clinical populations, also limits the generalisability of the information to the general population. There are also differences in the methodology used, with some studies using telephone interviews, such as Computer Assisted Telephone Interviewing (CATI) (Hintikka et al. 1998; Crosby, Cheltenham & Sacks 1999; De Leo et al. 2005), and others using face-to-face interviews (e.g. Bertolote et al. 2005; Beautrais et al. 2006; Borges et al. 2007; Levinson et al. 2007). These different methodologies often result in varying response rates. In adolescents anonymous surveys have been found to result in a suicide attempt prevalence that is much higher than in non-anonymous surveys (Safer 1997).

Table 2.1: Surveys collecting the prevalence of suicide-related behaviour

Author	Sample size	Age Range (years)	Prevalence in last year (%)	Lifetime prevalence (%)	Country
Beautrais et al. (2006)[(a)]	12,992	16+	0.4	4.5	New Zealand
Begginton et al. (2010)[(a)^]	8,580	16 to 74	0.6	4.4	Britain
Bertolote et al. (2005)[(b)]	500 to 50,000	5+ (varies by country)	-	0.4 – 4.2	multiple
Borges et al. (2006)[(a)**]	5,692	18+	0.4	-	United States
Borges et al. (2007)[(a)]	5,782	18 to 65	-	2.7	Mexico
Crosby, Cheltenham and Sacks (1999)[(c)]	5,238	18+	0.7	-	United States
De Leo et al. (2005) [(c)]	11,572	18 to 39	0.4	-	Australia
Druss and Pincus (2000)[(a)]	7,589	17 to 39	-	5.5	United States

** Refers to suicide attempts as the study assessed intention to die.
(a) Face-to-face interview collection method.
(b) Predominantly face-to-face, but self-completed and telephone used in several areas.
(c) Telephone collection method.
(d) This article combined information from 5,388 responses collected by the National Comorbidity Survey and 4,320 responses collected by the National Comorbidity Survey Replication.
(e) Hardcopy collection method (on site).
(f) This is the same information reported by Kessler, Borges and Walters (1999), but limited to only suicide attempters.
(g) Postal collection method.
^ Refers to most recent occurrence.

Table 2.1: Surveys collecting the prevalence of suicide-related behaviour continued

Author	Sample size	Age Range (years)	Prevalence in last year (%)	Lifetime prevalence (%)	Country
Fairweather et al. (2006)	7,485	20 to 64	0.8	-	Australia
Hintikka et al. (1998)[(c)]	4,868	18 to 74	0.9 for women, 1.1 for men	-	Finland
Kessler, Borges and Walters (1999)[(a)]	5,877	15 to 54	-	4.6	United States
Kessler et al. (2005) [(a)**]	9,708 [(d)]	18 to 54	0.4 (NCS), 0.6 (NCS-R)	-	United States
Kovess-Masfety et al. (2011)[(a)]	2,894 (F) 5,473 (S)	18+	-	3.4 (F) 1.5 (S)	France (F) & Spain (S)
Johnston, Pirkis and Burgess (2009)	8,841	16 to 85	0.4	3.2	Australia
Levinson et al. (2007)[(a)]	4,859	21+	-	1.4	Israel
Meehan et al. (1992)[(e)]	694	18 to 24	1.9	10.4	United States
Ono et al. (2008)[(a)]	2,436	20+	-	1.9	Japan

** Refers to suicide attempts as the study assessed intention to die.
(a) Face-to-face interview collection method.
(b) Predominantly face-to-face, but self-completed and telephone used in several areas.
(c) Telephone collection method.
(d) This article combined information from 5,388 responses collected by the National Comorbidity Survey and 4,320 responses collected by the National Comorbidity Survey Replication.
(e) Hardcopy collection method (on site).
(f) This is the same information reported by Kessler, Borges and Walters (1999), but limited to only suicide attempters.
(g) Postal collection method.
^ Refers to most recent occurrence.

Table 2.1: Surveys collecting the prevalence of suicide-related behaviour continued

Author	Sample size	Age Range (years)	Prevalence in last year (%)	Lifetime prevalence (%)	Country
Nock and Kessler (2006)[(a)(f)**]	5,877	15 to 54	-	2.7	United States
Nock et al. (2008)[(a)]	84,850	Adults (not stated)	-	2.7	17 countries
Pirkis, Burgess and Dunt (2000)[(a)]	10,641	18+	0.4	3.6	Australia
Ramberg and Wasserman (2000)[(g)]	8,800	20 to 64	0.4	3.6	Sweden
Renberg (2001)[(g)]	636	18 to 65	0.2	2.7	Sweden
Scocco et al. (2008)[(a)]	4,712	18+	-	0.5	Italy
Tomlin, Joyce and Patterson (2012)[(c)]	6,930	16+	0.3	-	Australia
Weissman et al. (2000; 1996)	38,000		-	0.7 - 5.9	9 countries
Wood and Daly (2007)[(c)]	5,327	16+	0.6	-	Australia
Zhang et al. (2005)	7,361	17 to 39	-	7.6 for women, 3.7 for men	United States

** Refers to suicide attempts as the study assessed intention to die.
(a) Face-to-face interview collection method.
(b) Predominantly face-to-face, but self-completed and telephone used in several areas.
(c) Telephone collection method.
(d) This article combined information from 5,388 responses collected by the National Comorbidity Survey and 4,320 responses collected by the National Comorbidity Survey Replication.
(e) Hardcopy collection method (on site).
(f) This is the same information reported by Kessler, Borges and Walters (1999), but limited to only suicide attempters.
(g) Postal collection method.
^ Refers to most recent occurrence.

2.5.2. Prevalence of Suicide ideation

Suicide ideation is regarded as a necessary antecedent of suicide and suicide attempts (Goldney et al. 2000; Brezo, Paris, Tremblay, et al. 2007) and so an understanding of the prevalence of suicide ideation is necessary for the monitoring of psychological distress and to prevent the progression of more serious problems. Information on suicide ideation is only available as a self-reported measure and so the prevalence of suicide ideation is also derived from health surveys.

As with suicide-related behaviour, the prevalence of suicide ideation is generally reported either as a lifetime prevalence or as a period prevalence, generally relating to the previous 12 months, as shown in Table 2.2. The lifetime prevalence of suicide ideation is found to vary widely, from 5.5% of 21 year olds and over in an Israeli study to 53.9% of 18 to 24 year old university students in the US. Similarly, across the world the prevalence of suicide ideation in the last year has varied, generally from 2.3% to 8%.

As with suicide-related behaviour, the prevalence estimates of suicide ideation may vary greatly depending on the questions used and the population surveyed (Watson et al. 2001) and so the comparability of these studies is limited by the use of these different questions. For example, the suicide ideation in Levinson et al.'s (2007) asked "Have you ever seriously thought about committing suicide", while Meehan et al.'s (1992) asked "Have you EVER had thoughts of taking your life, even if you would not really do it?" and "During the PAST 12 MONTHS have you had such thoughts?" (1992, 44). Taylor et al.'s (2007) study was based on four questions from the General Health Questionnaire and was in reference to the past few weeks.

As the prevalence of suicidal behaviour differs among different ages, the comparability of such information is also limited by the restricted age groups used by some studies (e.g. Meehan et al. 1992; Kessler, Borges & Walters 1999; Druss & Pincus 2000), as well as by the variety of collection methodologies. Brezo et al. (2007) have suggested that cross-sectional surveys underestimate the true prevalence of lifetime suicide

behaviour. They conducted a prospective study following a school cohort through to their early twenties and found that lifetime suicidal ideation based on retrospectively examined reports were 33% higher than self-reported lifetime prevalence estimates (Brezo et al. 2007).

Table 2.2: Surveys collecting the prevalence of suicide ideation

Author	Sample size	Age Range (years)	Prevalence in last year (%)	Lifetime prevalence (%)	Country
Beautrais et al. (2006)[(a)]	12,992	16+	3.2	15.7	New Zealand
Begginton et al. (2010)[(a)^]	8,580	16 to 74	3.5	12.0	Britain
Bertolote et al. (2005)[(b)]	500 to 50,000	5+ (varies by country)	-	2.6 – 25.4	Multiple
Borges et al. (2006)[(a)]	5,692	18+	2.6	-	United States
Borges et al. (2007)[(a)]	5,782	18 to 65	-	8.1	Mexico
Crosby, Cheltenham and Sacks (1999)[(c)]	5,238	18+	5.6	-	United States
De Leo et al. (2005) [(c)]	11,572	18 to 39	-	10.4	Australia
Druss and Pincus (2000)[(a)]	7,589	17 to 39	-	16.3	United States

(a) Face-to-face interview collection method.
(b) Predominantly face-to-face, but self-completed and telephone used in several areas.
(c) Telephone collection method.
(d) This article combined information from 5,388 responses collected by the National Comorbidity Survey and 4,320 responses collected by the National Comorbidity Survey Replication.
(e) Paper collection method (on site).
(f) Postal collection method.
(g) Ideation refers to the last few weeks.
^ Refers to most recent occurrence.

Table 2.2: Surveys collecting the prevalence of suicide ideation continued

Author	Sample size	Age Range (years)	Prevalence in last year (%)	Lifetime prevalence (%)	Country
Fairweather et al. (2006)	7,485	20 to 64	8.2	-	Australia
Goldney et al. (2000)[(c)]	2,501	18+	5.4	-	Australia
Gunnell et al. (2004)[(a)]	2,404	16 to 74	2.3	-	Great Britain
Hintikka et al. (1998)[(c)]	4,868	18 to 74	2.3	-	Finland
Johnston, Pirkis and Burgess (2009)	8,841	16 to 85	2.3	13.3	Australia
Kessler, Borges and Walters (1999)[(a)]	5,877	15 to 54	-	13.5	United States
Kessler et al. (2005) [(a)]	9,708 [(d)]	18 to 54	2.8 (NCS), 3.3 (NCS-R)	-	United States
Kovess-Masfety et al. (2011)[(a)]	2,894 (F) 5,473 (S)	18+	-	12.4 (F) 4.4 (S)	France & Spain
Levinson et al. (2007)[(a)]	4,859	21+	-	5.5	Israel
Meehan et al. (1992)[(e)]	694	18 to 24	25.6	53.9	United States

(a) Face-to-face interview collection method.
(b) Predominantly face-to-face, but self-completed and telephone used in several areas.
(c) Telephone collection method.
(d) This article combined information from 5,388 responses collected by the National Comorbidity Survey and 4,320 responses collected by the National Comorbidity Survey Replication.
(e) Paper collection method (on site).
(f) Postal collection method.
(g) Ideation refers to the last few weeks.

Table 2.2: Surveys collecting the prevalence of suicide ideation continued

Author	Sample size	Age Range (years)	Prevalence in last year (%)	Lifetime prevalence (%)	Country
Nock et al. (2008)[(a)]	84,850	Adults (not stated)	-	9.2	17 countries
Ono et al. (2008)[(a)]	2,436	20+	-	10.9	Japan
Pirkis, Burgess and Dunt (2000)[(a)]	10,641	18+	2.9	14.3	Australia
Ramberg and Wasserman (2000) [(f)]	8,800	20 to 64	7.3	20.3	Sweden
Renberg (2001)	636	18 to 65	8.6	21.1	Sweden
Scocco et al. (2008)[(a)]	4,712	18+	-	3.0	Italy
Taylor et al. (2007)[(c)(g)]	5,037	16+	4.7	-	Australia
Tomlin, Joyce and Patterson (2012)[(c)]	6,930	16+	3.6	-	Australia
Weissman et al. (2000; 1996)	38,000		-	2.1 - 18.5	nine countries
Wood and Daly (2007)[(c)]	5,327	16+	5.3	-	Australia

(a) Face-to-face interview collection method.
(b) Predominantly face-to-face, but self-completed and telephone used in several areas.
(c) Telephone collection method.
(d) This article combined information from 5,388 responses collected by the National Comorbidity Survey and 4,320 responses collected by the National Comorbidity Survey Replication.
(e) Paper collection method (on site).
(f) Postal collection method.
(g) Ideation refers to the last few weeks.

2.6. Associates of suicidal behaviour

An understanding of both the prevalence of suicidal behaviour and the associated risk factors is essential, not only for health professionals but for policy makers to be able to make steps towards prevention (Sayer, Stewart & Chipps 1996; Hintikka et al. 1998; Druss & Pincus 2000; Lawrence et al. 2001). Much of the research into suicide has looked at factors that can be used to predict suicide in the future. Research into suicide is important for the potential prediction and prevention of deaths and also for monitoring the high distress level associated with suicidal behaviour (Levinson et al. 2007). While many significant predictors have been found, as yet their discriminative ability has remained poor, with risk factors not able to accurately predict suicide and lacking in specificity (Goldney et al. 2000). For example, while Harriss and Hawton (2005) were able to correctly predict two-thirds of respondents exhibiting suicide-related behaviour who subsequently completed suicide using the Suicide Intent Scale (SIS), 96% of those predicted to suicide did not, giving a Positive Predictive Value (PPV) of only 4%. Similarly, Fu (2007) only achieved a PPV of 5.2% and have suggested that sensitivity may be of more use in screening than PPV as the identification of people at risk of suicide is the greatest priority. Other efforts have been made to predict suicide attempters from ideators. Borges (2006) created a risk factor index, which was able to distinguish 89% of ideators who attempted suicide in the past year from those who did not.

The information about the risk factors associated with suicidal behaviour come from a range of different types of studies, including health surveys, administrative data sources, follow-up studies and psychological autopsies. As results from large scale population surveys are able to be generalised to the population they are able to be used to inform associations between suicidal behaviour and risk factors (Pirkis, Burgess & Dunt 2000). However, these self-reported studies may suffer from inaccuracies in recall. While studies using objective measures, such as administrative health records, do not suffer from this recall bias they are restricted to medically seriously attempts and may suffer

from differences between hospitals in regards to what is classified as an admission (Cantor & Neulinger 2000) and how likely one is to be admitted.

As one of the strongest predictors of suicide is a previous attempt, most follow-up studies have been based on populations of suicide attempters/gesturers (Ostamo & Lönnqvist 2001; Beautrais 2004). The duration of follow-up varies widely between studies, from one (Hjelmeland 1996b) to 37 years (Suominen, Isometsa, Suokas, et al. 2004), making it difficult to compare the proportion of suicide attempters/gesturers who go on to commit suicide. In addition, these studies often use different age groups and population cohorts. However, these studies are able to provide information regarding the similarities and differences between those who do and don't commit suicide.

As many studies investigating risk factors for suicide attempts have compared suicide attempters to respondents with no suicidal behaviour, the risk factors that have been found to be significant may be associated with self-injury in general rather than suicide attempts (Nock & Kessler 2006). Given the higher lethality and risk of death associated with suicide attempts compared with suicide gestures it is important to be able to determine risk factors that are related to suicide attempts rather than suicide gestures (Nock & Kessler 2006).

2.6.1. Previous attempts

A previous suicide attempt is one of the strongest predictors of suicide (Lawrence et al. 2000; Ostamo & Lönnqvist 2001; Beautrais 2004; Suokas et al. 2001; Beautrais; Iribarren et al. 2000) and of a subsequent suicide-related behaviour (Borges et al. 2006). In a self-report study in the United States around half the suicide attempters reported to have made more than one attempt in the past 12 months (Crosby, Cheltenham & Sacks 1999). But while suicide and medically serious suicide attempts share many common risk factors, they are somewhat different groups - while males complete suicide more than females, the converse is true of suicide attempts; suicide completers are older than attempts and tend to use more lethal methods (Beautrais 2001).

2.6.2. Gender

There are considerable gender differences in suicidal behaviour (Hawton 2000). In most countries the suicide rate of males is higher than that of females (Hawton 2000). This greater risk of suicide in males is also supported by follow-up studies (e.g. (Hjelmeland 1996b; Holley, Fick & Love 1998a; Beautrais 2001; Suokas et al. 2001; Suominen, Isometsa, Ostamo, et al. 2004; Gibb, Beautrais & Fergusson 2005).

In contrast, rates of deliberate self-harm are much higher in females compared with males (Hawton 2000; Iribarren et al.). Similarly, a significantly higher lifetime prevalence of suicide–related behaviour (e.g. (Weissman et al. 2000; Meehan et al. 1992; Beautrais et al. 2006; Hawton et al. 2000; Kessler, Borges & Walters 1999; Levinson et al. 2007; Borges et al. 2007; Zhang et al. 2005; Druss & Pincus 2000; Johnston, Pirkis & Burgess 2009; Nock et al. 2008) is found in females compared with males. This gender difference is supported by some (Meehan et al. 1992; Johnston, Pirkis & Burgess 2009), but not all (Beautrais 2001; Beautrais et al. 2006) studies that assess the prevalence of suicide-related behaviour in the past year.

There is also a gender difference found in the prevalence of suicide ideation. A significantly higher lifetime prevalence of suicide ideation is found in females compared with males (De Leo et al. 2005; Meehan et al. 1992; Beautrais et al. 2006; Levinson et al. 2007; Borges et al. 2007; Druss & Pincus 2000; Johnston, Pirkis & Burgess 2009; Nock et al. 2008). However, as with suicide-related behaviour, the gender difference is less clear when looking at the prevalence in the past year. While a significantly higher prevalence of suicide ideation in the past year is found in females compared with males in some studies (Beautrais et al. 2006), this is not found in others (Crosby, Cheltenham & Sacks 1999; Meehan et al. 1992; Renberg 2001). Differing methodologies, small sample sizes and low response rates may account for the negative findings in some studies (Suominen, Isometsa, Ostamo, et al. 2004).

There are also other gender differences in behaviours that effect suicide rates and the prevalence of suicide-related behaviour. Compared with males females are twice as likely to go to a hospital after a suicide-related behaviour (De Leo et al. 2005); are more likely to seek help for mental health problems (Hawton 2000); and tend to use less violent methods (Cantor & Baume 1998; Denning, Yeates Conwell & Cox 2000; Hawton 2000). These behaviours would result in both a greater survival from suicide-related behaviour and a greater representation in studies based on administrative health records.

2.6.3. Mental Health

Along with a previous suicide attempt, a mental health problem is one of the most significant predictors of suicidal behaviour, including suicide (Beautrais 2000, 2001; Kuo, Gallo & Tien 2001; Beautrais 2003; Yutaka et al. 2008; Nock et al. 2008). It is associated with an increased risk of both suicide ideation (Levinson et al. 2007; Borges et al. 2006; Beautrais et al. 2006; Gunnell et al. 2004) and suicide-related behaviour (Levinson et al. 2007; Taylor et al. 2004; Zhang et al. 2005; Pirkis, Burgess & Dunt 2000; Beautrais et al. 2006).

A study of Western Australian hospital admissions for suicide-related behaviour found that 81% of those who survived at least 6 months after the attempt were diagnosed with a mental disorder (Lawrence et al. 2001). Van Casteren et al.'s (1993) study of the Belgium GP sentinel found that over 40% of patients who attempted/completed suicide had been treated for a mental disorder, mainly depression, in the previous year.

The mortality rate of people with a mental disorder is 2.5 times higher than the general population with the greatest increased risk of death a result of suicide (Lawrence & Coghlan 2002). In addition, people with a mental disorder are more than seven times as likely to suicide compared with those with no mental disorder (Lawrence & Coghlan 2002).

In a national Australian survey to determine the prevalence of mental disorders, almost half (45%) of 16 to 85 year olds reported having experienced a mental disorder at some time during their lives (Australian Bureau of Statistics 2008d), pointing to a large population potentially at risk of suicidal thoughts and behaviours. Furthermore, one in five Australians had experienced a mental disorder in the last year, with women experiencing higher rates than men and the rate of mental health decreasing with age (Australian Bureau of Statistics 2008e). These findings replicated those of its predecessor, the 1997 Australian National Survey of Mental Health and Well-being (Andrews, Henderson & Hall 2001).

Within Western Australia (WA), anxiety and depression account for the majority of the burden attributed to years living with a disability and is the second most common burden of disease, behind ischaemic heart disease (Department of Health Epidemiology Branch 2010). Suicide and self injury account for 2.2% of the total disease burden of the state (Department of Health Epidemiology Branch 2010).

2.6.4. Contact with Health Services

Contact with health services prior to a fatal suicide provides opportunities for prevention and intervention. In a review of studies for which there was information available on health care contact, Luoma, Martin and Pearson (2002) found that around three-quarters of people who commit suicide had contact with primary care services in the year prior to their suicide. However, Beautrais (2006) found that only 54% of those who reported a suicide-related behaviour attempt had visited a health professional in the last year. While there is discrepancy about the extent of those using health services, these studies point to the potential opportunity for prevention and intervention in a large number of suicide cases.

Between one-quarter (Appleby et al. 1999) and one-third (Luoma, Martin & Pearson 2002) of people committing suicide had contact with mental health services in the year prior to their suicide. When restricted to contact in the month prior to suicide one in five

had contact with mental health services while around 45% to 60% had contact with primary providers (Luoma, Martin & Pearson 2002; Van Casteren et al. 1993). However, in a UK study the majority of people who committed suicide were believed to have been at no or low immediate risk of suicide at the final service contact (Appleby et al. 1999).

There is also opportunity for intervention with people exhibiting suicide-related behaviour who seek help after their act. However, it is difficult to determine what proportion of these people makes contact with health services as a result of their behaviour. One of the reasons that suicide attempters/gesturers may not seek help is because of the shame they feel as a result of their behaviour (Wiklander, Samuelsson & Asberg 2003). Studies that use administrative health records, such as hospital admissions are restricted to only the cases that do seek help, which may often be the most medically serious cases. Hence the similarities between people who are seen by health care services and those who are not remain a largely unknown area (Diekstra 1993). The estimates of those who seek medical help for suicide-related behaviour range from around 25% to 66% (Meehan et al. 1992; Safer 1997; Crosby, Cheltenham & Sacks 1999; Renberg 2001; De Leo et al. 2005), while between 10% to 30% of people self-reporting suicide-related behaviour are estimated to be admitted to hospital (Meehan et al. 1992; Crosby, Cheltenham & Sacks 1999). The differences in findings may be a result of differing methodologies, ages of the sample and societal variations in the social acceptability of seeking help, particularly mental health services.

2.6.5. Age

While there is some inconsistency in the literature regarding the association between suicidal behaviour and age, several follow-up studies have found that the risk of suicide was greater for older than younger respondents (Hjelmeland et al. 1998; Beautrais 2001; Gibb, Beautrais & Fergusson 2005). Furthermore, an increase in age has found to be associated with higher suicidal intent (Harriss, Hawton & Zahl 2005).

In contrast, suicide ideation (Kessler, Borges & Walters 1999; Renberg 2001; De Leo et al. 2005; Gibb, Beautrais & Fergusson 2005; Beautrais et al. 2006; Borges et al. 2007; Levinson et al. 2007; Crosby, Cheltenham & Sacks 1999; Kuo, Gallo & Tien 2001; Johnston, Pirkis & Burgess 2009; Nock et al. 2008) and suicide-related behaviour are more likely in younger than older respondents (Kessler, Borges & Walters 1999; De Leo et al. 2005; Gibb, Beautrais & Fergusson 2005; Beautrais et al. 2006; Borges et al. 2007; Levinson et al. 2007; Kuo, Gallo & Tien 2001; Johnston, Pirkis & Burgess 2009; Nock et al. 2008).

While some studies have not found an association with age and suicide-related behaviour (Druss & Pincus 2000; Hjelmeland 1996b) or as a significant predictor of suicide (Ostamo & Lönnqvist 2001), the lack of associations may be a result of the limited age range included in their study or small sample sizes (Gibb, Beautrais & Fergusson 2005).

In contrast to suicide rates, the rates of mental health disorders have been found to decrease with age (Australian Bureau of Statistics 2008e). So, the higher suicide ideation found in younger people may be linked to the higher mental health disorders found in these age groups.

2.6.6. Geographic variation

The suicide rate is higher in rural compared with urban areas (Australian Bureau of Statistics 2007d). This geographic variation is found both in Australia and in other countries. For example, in China the suicide rate was found to be three times higher in rural areas compared with urban areas and this difference was found for both men and women as well as in all age-groups (Phillips, Li & Zhang 2002). There are several possible explanations for this geographic difference including psycho-social factors and access to lethal methods, such as firearms and hanging. Phillips, Li and Zhang (2002) have suggested that the availability of toxic pesticides in the homes of rural residents

and the lack of rural medical personnel who are well trained in the management of pesticide poisoning result in high mortality rates in those who did not intend to die.

In Australia this variation may also point to access to firearms and hanging. It may also reflect the differences in the availability and accessibility of health services, such as GPs, community and inpatient mental health services. A recent report by the Australian Institute of Health and Welfare found that the age standardised health expenditure per person for Medicare services reduced with increasing level of remoteness, from $761 in major cities to $390 in very remote areas (Australian Institute of Health & Welfare 2011). Alternatively, it could be a reflection of the distance and time required for appropriate care.

In WA between 2003 and 2007 suicide rates were significantly higher among residents in rural or remote areas compared with those in the metropolitan areas (Department of Health Epidemiology Branch & Cooperative Research Centre for Spatial Information (CRC-SI) 2011b). Similarly, males from rural and remote areas had a significantly higher hospitalisation rate for intentional self-harm than those in metropolitan areas between 2005 and 2009. However, in women only a difference between metropolitan and remote areas was found (Department of Health Epidemiology Branch & Cooperative Research Centre for Spatial Information (CRC-SI) 2011a). Geographic isolation, difficulties accessing services and availability of lethal methods of self harm have been attributed as influencing factors on this increase. Furthermore, in WA the remote areas, such as in the Kimberley, have a greater proportion of ATSI people, who have a higher suicide rate than non-ATSI people (Ministerial Council for Suicide Prevention 2011b).

2.6.7. Family

Suicide is found to aggregate in families, suggesting a role of family factors in suicidal behaviour (Statham et al. 1998; Pedersen & Fiske 2010; De Leo & Heller 2008; Brent 2010). However, findings from adoption studies have lead to the suggestion that genetic

factors rather than familial environmental factors are associated with suicidal behaviour (Statham et al. 1998). Overall, genetic factors account for around 45% of the variance in suicidal thoughts and behaviour (Statham et al. 1998). This genetic factor may however, point to an underlying genetic link in mental health.

De Leo et al. (2005) found that after controlling for age and sex, personally knowing someone who attempted or committed suicide increased the risk of suicide ideation and suicide attempts. This finding may highlight the contagious nature of suicide and is one of the reasons behind the media recommendations regarding the reporting of suicide.

2.6.8. Risk of dying

The risk of dying from suicide is greatest within 12 months of a suicide-related behaviour (Hawton, Zahl & Weatherall 2003; Ostamo & Lönnqvist 2001; Holley, Fick & Love 1998a). Similarly, the greatest risk of a suicide-related behaviour exists within the first 12 months of suicide ideation (Levinson et al. 2007; Borges et al. 2007).

In Harriss et al.'s (2005) follow-up study a significantly greater proportion of patients with high SIS scores at their index died within 12 months of their index attempt compared with patients with low SIS scores. Suokas et al.(2001) found that in their follow-up study of self-poisoning the risk of suicide remained elevated when compared with the general population for more than a decade after the index attempt.

2.6.9. Socio-economic factors

Socio-economic status is associated with suicide ideation, suicide and mental health in general. Low socio-economic status is associated with increased suicide ideation (Gunnell et al. 2004), suicide-related behaviour (Kuo, Gallo & Tien 2001; Burrows et al. 2010; Taylor et al. 2004) and associated with higher suicide rates (Ministerial Council for Suicide Prevention 2011b; Burrows et al. 2010; Andrés & Halicioglu 2010). In

addition, mental disorders, particularly depression, are more prevalent in people with a low socio-economic status (Australian Bureau of Statistics 2008e).

While suicide ideation is found to be associated with low household income (Beautrais et al. 2006; Crosby, Cheltenham & Sacks 1999), Andrés (2010) found that higher income was associated with higher suicide rates. Employment status is found to be associated with both suicide ideation (Crosby, Cheltenham & Sacks 1999), suicide-related behaviour (Crosby, Cheltenham & Sacks 1999; Taylor et al. 2004; Pirkis, Burgess & Dunt 2000; Hawton et al. 2003; Carter, Page & Taylor 2007), suicide (Andrés & Halicioglu 2010) and mental health disorders (Andrews, Henderson & Hall 2001).

Low education is found to be associated with both suicide ideation (Taylor et al. 2004; Borges et al. 2007) and suicide-related behaviour (Kessler, Borges & Walters 1999; Iribarren et al. 2000; Borges et al. 2007). Similarly, higher education is associated with lower prevalence of mental health disorders (Andrews, Henderson & Hall 2001).

There are also differences with marital status. Being divorced, separated or widowed is associated with both suicide ideation (Crosby, Cheltenham & Sacks 1999; Taylor et al. 2007) and suicide-related behaviour (Kessler, Borges & Walters 1999; Kuo, Gallo & Tien 2001). While being divorced is associated with higher suicide rates (Andrés & Halicioglu 2010), being not married or in a defacto relationship is associated with both attempted suicide and ideation in past year (Pirkis, Burgess & Dunt 2000) and suicide-related behaviour (Hawton et al. 2003). Similarly, mental health disorders are less prevalent in the currently married (Andrews, Henderson & Hall 2001).

2.6.10. Living arrangements

Information regarding living arrangements provides an indication of the social support accessible to a person (Australian Bureau of Statistics 2008e). People living in a one parent family with children are more likely to have a mental disorder than people living

as a couple with no children (Australian Bureau of Statistics 2008e). However, age may account for some of these findings as living arrangements are associated with age (Australian Bureau of Statistics 2008e). Living alone is associated with suicide ideation (Renberg 2001).

2.6.11. Physical health

Physical illness is associated with suicide (Ministerial Council for Suicide Prevention 2011b; Suokas et al. 2001; Spoletini et al. 2011), as well as suicide ideation and suicide-related behaviour (Druss & Pincus 2000). This association has a significant dose-response relationship between the number of prior disorders and odds of suicide-related behaviour (Kessler, Borges & Walters 1999; Druss & Pincus 2000) and suicide ideation (Borges et al. 2006; Druss & Pincus 2000). In a US study Kessler et al. (1999) found that people with three or more risk factors (9.2% of the sample) accounted for more than half (55.1%) of those who made a lifetime suicide-related behaviour.

Druss and Pincus (2000) found that people reporting ever having asthma or cancer were more than four times as likely to report a suicide attempt, suggesting that suicide and medical illness are mutually reinforcing. Several studies have found a linear association between the number of physical illnesses and likelihood of suicide attempt (Goodwin, Marusic & Hoven 2003; MacLean et al. 2011).

Australians living in rural areas are generally less healthy than those living in urban areas, particularly for men (Alston 2010). If suicide is related to poor health this may help to explain the higher suicide rate in regional Australia. Similarly, the older population is more likely to have developed chronic physical illnesses, which may help to explain the higher suicide rate in this cohort.

In recent years there is a suggestion of an association between body mass index (BMI) and suicide-related behaviour, with a Swedish study of men finding that those with a lower BMI had an increased risk of attempted suicide (Batty et al. 2010). This finding is

in contrast to the positive association found between obesity and suicide ideation and suicide-related behaviour and also between obesity and mental health problems, including depression (Mather et al. 2009). However, as most of these associations were found to exist only in women (Mather et al. 2009) the gender differences in these studies may account for the contrasting findings.

There is also evidence to suggest that alcohol use is significantly associated with both suicidal ideation (Han et al. 2009) and suicide-related behaviour (Han et al. 2009; Lopez-Castroman et al. 2011), even among those not reporting suicide ideation (Schilling et al.). While there may be an association with alcohol and suicides (Lopez-Castroman et al. 2011; Ministerial Council for Suicide Prevention 2011b), heavy alcohol use can limit a Coroner's ability to classify a death as a suicide due to its impairment on one's judgement (Beacham 2008).

Several studies have reported a positive relationship between smoking and suicidal behaviour (Riala, Hakko & Räsänen 2008; Hawton & van Heeringen 2009), with smoking found to be positively associated with suicidal ideation (Han et al. 2009; Hintikka et al. 2009) and suicide-related behaviour (Han et al. 2009) and smokers more likely to report mental health problems in the last year than non-smokers (Australian Bureau of Statistics 2008e). However, Kessler et al. (2009) found that smoking was associated with suicide ideation, but not other suicide-related behaviours. Riala, Hakko and Räsänen (2008) found that smoking status modified the risk of suicide associated with affective and neurotic disorders and substance-related disorders only.

2.6.12. Hopelessness

Hopelessness, low self-esteem and low sense of control over life are known to be risk factors for suicide (Ministerial Council for Suicide Prevention 2011b) as well as suicide-related behaviour (Beautrais 2004) and suicide ideation (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998). Psychological distress has also found to be associated with suicide ideation (Taylor et al. 2007; Chamberlain et al. 2009).

2.6.13. Life stresses

There are many stressful events that can happen in ones live, such as the death of a family member or friend, losing one's job, financial stress or illness. These life stresses, including financial stress, family difficulties and legal stress are associated with high suicide ideation prevalence (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998). Similarly, stressful life events are also associated with suicide (Moscicki 1995).

2.7. Suicide prevention

Monitoring suicides and suicidal behaviour is a key component of suicide prevention strategies (Gairin, House & Owens 2003). Despite the volumes of information about risk factors and suicidal behaviour, there is little evidence-based information regarding interventions that successfully prevent or reduce suicides (Beautrais 2005). Interventions that have been supported by evidence include restrictions on access to methods of suicide, such as domestic gas, which have been shown to reduce suicides by that particular method (Beautrais 2005).

As there are multiple factors associated with suicide, suicide prevention needs to be multi-faceted, with a focus on mental health (Mann et al. 2005). Knowledge and beliefs about mental health are a barrier for the recognition and treatment for depression (Goldney et al. 2005). Interventions that aim to change public opinions and attitudes toward mental illness, such as those in Germany that increase awareness about depression, may help in the prevention of suicide (Beautrais 2005). Mann et al. (2005) suggest the need for public education campaigns that aim to increase the recognition of those at risk of suicide and to increase help seeking behaviour by improving the understanding of the causes and risk factors of suicide. These campaigns also aim to reduce the social stigma associated with suicide and mental illness, and challenge the notion of suicide as being inevitable (Mann et al. 2005). The World Suicide Prevention Day held on September 10th each year is an international campaign to increase

awareness and reduce the stigma of suicide (International Association for Suicide Prevention n.d).

The inconsistency in definitions of suicidal behaviour creates confusion in suicide prevention in regards to what should be the focus (Cantor & Baume 1998). Cantor and Baume (1999) suggest the multiple causative factors of suicide prevent opportunities for prevention, all of which should be addressed by a comprehensive suicide prevention strategy. Suicide prevention has primarily focused on identifying individual risk factors rather than regarding population mental health as consisting of complex social and ecological relationships (McMichael 1999 cited in Knox, Conwell & Caine 2004).

Using the disease prevention stages primary prevention would be aimed at the population and be both relevant and acceptable; secondary prevention would require the identification and intervention of individuals with suicidal ideation or risk factors associated with suicide, few of whom would result in suicide; and tertiary prevention would be aimed at those who are at risk of suicide and may involve services to those who have previously made a suicide attempt (Lester 1989 cited in Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998). Most suicide prevention efforts have been either secondary or tertiary prevention strategies (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998).

Primary prevention strategies of suicide would involve prevention of suicidal ideation in the first place and would involve helping individuals cope with life stressors by enhancing self-esteem, mastery and support where needed (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998). As suicidal outcomes are rare, such prevention strategies would increase psychological health in general (Lester 1989 cited in Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998). This would include reducing the stigma associated with mental health problems and increasing coping strategies for people experiencing stresses. As people with mental illness have been found to have an increased risk of suicidal behaviour, public education programs that improve the recognition of both mental disorders and suicide risk are vital (Lawrence et

al. 2000). Given that the majority of people who suicide had contact with health providers prior to their suicide, prevention needs to also incorporate screening of depressed patients by primary care physicians (Mann et al. 2005).

Carter, Page and Taylor (2007) has posited that as suicide ideation may be a symptom of depression with only a limited relationship to suicide attempts and suicide, it may be of limited value as a target for national suicide prevention strategies. However, as suicide is regarded as a public health problem, Knox, Conwell and Caine (2004) cite 'Rose's Theorem' that "...a larger number of people at small risk may give rise to more cases of disease than a small number who are at high risk" (1989) (p. 39) to make a case for a public health approach to suicide prevention.

Knox, Conwell and Caine (2004) have compared suicide prevention to the prevention of cardiovascular disease (CVD), suggesting that suicide prevention, like CVD, needs to be considered within a complex paradigm of psychiatric, behaviour and social factors. They point to the varying suicide rates in different countries, suggesting that these are likely to relate to different cultural factors or to major social forces and suggest that if social and economic factors are determinants of suicide any solution also needs to take these into account. They highlight that only an approach that was aimed at the entire population at risk resulted in a significant reduction in CVD related mortality and morbidity (Gordon & Kannel 1971 cited in Knox, Conwell & Caine 2004).

Knox, Conwell and Caine (2004) highlight the transition CVD prevention underwent, from being predominantly a clinically focused approach to a population based approach. They suggest that suicide prevention remains stuck in a traditional clinical approach that is carried out at either an individual or population level. They highlight that the greatest successes in CVD prevention were through community driven approaches and argue that suicide preventions need to not only be the responsibility of mental health professionals in clinical settings but need to target communities.

For suicide prevention to be effective it needs to combine strategies targeted to both the population level and high-risk groups (Lewis et al. 1997 cited in Carter, Page & Taylor 2007). While authors such as Owens et al. (2002) suggest that a population based strategy is necessary to reduce suicide, there is also a need for tertiary prevention to improve the diagnosis, treatment and management of individuals in the high-risk group of people who have made a suicide attempt/gesture (Gibb, Beautrais & Fergusson 2005). Strategies also need to take into account the gender differences found in suicidal behaviour (Denning, Yeates Conwell & Cox 2000).

In regards to strategies that have been introduced, crisis centres and telephone hotlines, such as Lifeline in Australia, have been developed as a result of evidence that many suicide attempts follow stressful life events, while programs for high-risk school students aim to enhance self-esteem, problem solving and coping skills to protect young people (Beautrais 2005). However, there are difficulties in evaluating suicide prevention programs as suicide has a low prevalence and recent introduction of many national suicide prevention plans means there has not been time for their impact to be determined (Beautrais 2005).

In a review of international suicide prevention strategies Mann (2005) concluded that the impact of intervention strategies on suicide rates is difficult to estimate. However, they suggest that the most promising interventions are those that restrict access to suicide methods and those that educate physicians (and gatekeepers) (Mann et al. 2005). Educating physicians about the recognition of depression and the risk of suicide increases the number of diagnosed and treated individuals with depression (Mann et al. 2005) and hence is both a primary and secondary prevention strategy. The education of gatekeepers provides an opportunity for individuals at risk of suicide to be identified and directed toward assessment and treatment (Goldsmith, Pellmar, Kleiman, Bunney 2002 cited in Mann et al. 2005).

2.7.1. Suicide prevention in Australia

In Australia mental health has increased in prominence and recognition over the last few years. In 2010 Professor Patrick McGorry was named Australian of the Year in recognition of his work as a clinician, researcher and advocate for youth mental health (Australian of the Year n.d.). In the same year a Commonwealth Mental Health Minister was appointed and mental health became part of the national health reform agenda. In the following year (2011) the National Mental Health Commission was created to increase the prominence of mental health and to provide leadership to the mental health sector (*Ensuring quality, accountability and innovation, A new National Mental Health Commission,* 2011).

Australia was one of the first nations to create a national suicide prevention strategy (The Senate Community Affairs References Committee 2010), commencing in the mid 1990s. The current national suicide prevention framework, called the *Living is For Everyone (LIFE)* Framework built on these previous strategies and was first released in 2000 (Department of Health & Ageing 2007). The framework aims to improve awareness and understanding of suicide and the ways in which people can respond to suicidal behaviours in themselves or others. Australia also has a national *Mental Health Strategy*, which was first endorsed in 1992. It provides a framework for national reform to move away from inpatient based mental health care to community care (Department of Health & Ageing 2010b).

At a State level WA appointed its first Mental Health Minister in 2008 and this position was mandated to ensure suicide prevention was a priority for all State Government departments (Ministerial Council for Suicide Prevention 2011a). In 2009 a revised Ministerial Council for Suicide Prevention (MCSP) was appointed (Ministerial Council for Suicide Prevention 2011a), covering all ages and not just youth, which was the focus of its predecessor the Youth Suicide Advisory Committee (YSAC). The MCSP coordinates suicide prevention initiatives and develops strategies that will reduce suicide amongst those age and population sub groups known to be at high risk of suicide.

The Western Australian Suicide Prevention Strategy was released in 2009 and is aligned with the national *LIFE* framework (Department of Health Western Australia 2009). The strategy aims to change attitudes about suicide as well as promoting mental health and the involvement of community in suicide prevention approaches (Ministerial Council for Suicide Prevention 2011b). The MCSP will lead the strategy and make recommendations to the Minister for Mental Health regarding suicide issues (Ministerial Council for Suicide Prevention 2011b).

In March 2010 the WA Mental Health Commission (MHC) was created with Australia's first Mental Health Commissioner (Mental Health Commission 2010). The MHC does not provide mental health services, but is responsible for the policy and purchasing of these services across the state (Mental Health Commission 2010) and for the funds related to the WA Suicide Prevention Strategy (Ministerial Council for Suicide Prevention 2011b). In 2011 the MHC released its strategic plan, *Mental Health 2020: Making it personal and everybody's business*, which includes suicide prevention as one of its nine lead action areas (Mental Health Commission 2011).

While separate state and national Ministers of Mental Health and the separate Government agency of the Mental Health Commission do raise the profile of mental health issues it also brings with it questions as to the delineation of mental health. The separate responsibilities and funding streams for mental health may reduce the ability for our health system to function holistically. This issue of role delineation is further exacerbated by the divide between State and Commonwealth funding and responsibilities, where the Commonwealth is responsible for primary health care, i.e. GPs, but the States are responsible for hospital care. Hopefully the Council of Australian Governments (COAG) agreement of the National Action Plan on Mental Health 2006-2011 will go a way to address this problem (Department of Health & Ageing 2010a).

In Australia and WA there have been numerous health promotion campaigns to increase the awareness of mental health and to reduce the stigma of those with a mental health illness. *R U OK?* day is a national day of action to help prevent suicide by encouraging

people to start a conversation and ask “Are you ok?” (R U OK? 2011). The day began in 2009 and takes place on the 2nd Thursday of September, with an estimated 58% of Australians now aware of the initiative (R U OK? 2011). Australia has a national mental health week to raise awareness of mental health, which is held each October to coincide with World Mental Health Day. In WA *Act, Belong, Commit* is an evidence and community-based campaign that encourages people to actively improve their mental health (Act n.d.). This is by no means an exhaustive list of mental health promotion activities, but highlights the work being undertaken to increase the profile and to reduce the stigma of mental health issues.

CHAPTER THREE

METHOD

3.1. Study Sample

Respondents were 30,634 adults aged 16 years and over who completed the HWSS suicide module between March 2002 and June 2008. During the study period there were HWSS responses collected from an additional 7,238 adults aged 16 years and over, but these were excluded from the study as they were not asked suicide-related questions.

An additional 2,938 respondents who completed the HWSS between July and December 2008 were used in the external validation of models produced using logistic regression. These respondents were not included in any other part of the study.

3.2. Study Procedure

This study was conducted in two parts. Part A involved analyses of the HWSS data, while Part B involved analyses of the linked data.

3.2.1. Part A - HWSS

Part A analysed data collected by the HWSS between March 2002 and June 2008. The HWSS is a continuous data collection system that was developed to monitor the health and wellbeing of Western Australians. It collects information across a wide range of health related topics including chronic health conditions, lifestyle factors, socio-economic and demographic variables from at least 550 people[1] across the state each month. The HWSS has ethics approval from the WA Department of Health (DoH) Human Research Ethics Committee (HREC).

[1] This 550 people includes children, who were not part of this study. Additional information is provided in the Materials section.

During the study period the HWSS was conducted as a Computer Assisted Telephone Interview (CATI), where households were selected from the latest publicly available version of the Electronic White Pages (EWP) (annual versions of the EWP were available until 2004). Households were selected using a stratified random process to over-sample respondents in rural and remote areas to enable the HWSS to be disaggregated at smaller geographic levels. From 2002 to 2006 the sample was stratified by the nine Area Health Services (AHS). From 2007 onwards the sample was stratified by metropolitan (greater Perth area), remote (Pilbara and Kimberley) and rural (rest of state), known as the sample areas.

Households selected for the HWSS were sent an approach letter signed by the Director General of the DoH and a brochure. The letter and brochure explained the purpose of the survey, provided contact numbers for people to call and explained that someone from the house would be selected to participate. For the majority of the study period the person in the house with the next birthday was chosen as the respondent in an effort to avoid self-selection bias. However, this method was altered to a quota system around 2007, where people in younger age groups were actively asked for in 68 of every 100 calls so as to obtain sufficient numbers of younger people, who are harder to contact (Department of Health Western Australia, 2005; S. Joyce, personal communication 2011). Participation was voluntary with respondents able to decline to participate in the interview and able to withdraw at any time or refuse to answer any question(s).

The median length of the HWSS was approximately 22 minutes during the study period. The telephone interviews were completed by trained interviewers from the Edith Cowan University Survey Research Centre (ECU SRC), formerly the University of Western Australian SRC. All interviewers were trained and experienced in conducting CATI surveys and in collecting information that may be sensitive in nature. They were trained to the Market Research Society of Australia (MRSA) standards and had knowledge of the National Health and Medical Research Council (NHMRC) guidelines for research.

Each month the entire sample was telephoned. From 2002 to 2004 six phone calls were made to determine if a number was operational. From 2005 onwards this increased to 10 phone calls. No incentives were used to increase response rates. The response rates for each year are shown in Table 3.3. It was not possible to separate child responses, so these response rates are for the entire HWSS collection and not for just respondents included in this study. From 2005 onwards more detailed disposition codes were used, which enabled adjusted response rates to be determined.

Table 3.3: Response rates by year

Year	Response rate (a) (%)	Adjusted response rate (b) (%)	Participation rate (c) (%)
2002	58.1	68.2	68.5
2003	74.2	na	82.0
2004	75.0	na	81.7
2005	73.6	79.8	85.1
2006	74.5	80.2	86.8
2007	73.7	81.6	89.4
2008^	76.7	83.3	89.5

(a) Interviews divided by the eligible sample (i.e. non-operational, business and dedicated fax numbers were removed).
(b) Interviews divided by the eligible contacts (i.e. where the telephone was answered).
(c) Interviews divided by interviews plus refusals.
na not available
^ January to June

These data were weighted to compensate for the over-sampling in the rural and remote areas and adjusted to the age by gender distribution of the Western Australian population using the most recent Australian Bureau of Statistics (ABS) Estimated Resident Population (ERP) figures for each year (Department of Health Western Australia 2005a).

3.2.2. Part B – Linked Data

The HWSS asked respondents if they would agree for their information to be linked with other health data sets. Respondents who agreed to this then provided their full name and date of birth, and in 2008 their current address. Seventy seven per cent of the HWSS respondents in the study sample (23,575) agreed for their responses to be linked to other health information collected by the WA DoH (see Figure 3.1 for a pictorial representation of the linkage). The HWSS was linked to the following data sources, described below:

1) the Hospital Morbidity Database System (HMDS);
2) the Emergency Data Collection (EDDC);
3) the Mental Health Information System (MHIS); and
4) the Mortality Database (Deaths registered in WA only).

The full name, date of birth and address information, along with a unique identifier was provided to the DoH Data Linkage Unit (DLU) by the Manager, Health Outcomes Assessment Unit, who is responsible for the HWSS collection. The linkage was performed by the DLU using probabilistic matching techniques (Holman et al. 1999).

Once the HWSS responder list was linked to the other health datasets a mapping of HWSS person identifiers to a set of DLU linkage person identifiers was provided to a data manager within the DoH Epidemiology Branch, who was not involved in this project and not working with the HWSS information. Using this mapping file the data manager was able to attach the new person identifier to the HWSS dataset This new linkage person identifier, created specifically for this project, was also attached to all other health datasets, by their respective data managers, allowing all datasets to be merged without being identifiable.

This study received ethics approval from the Curtin University Human Research Ethics Committee (HREC) and the WA DoH HREC. As required by the DoH, no results are reported for instances of fewer than five cases to ensure confidentiality.

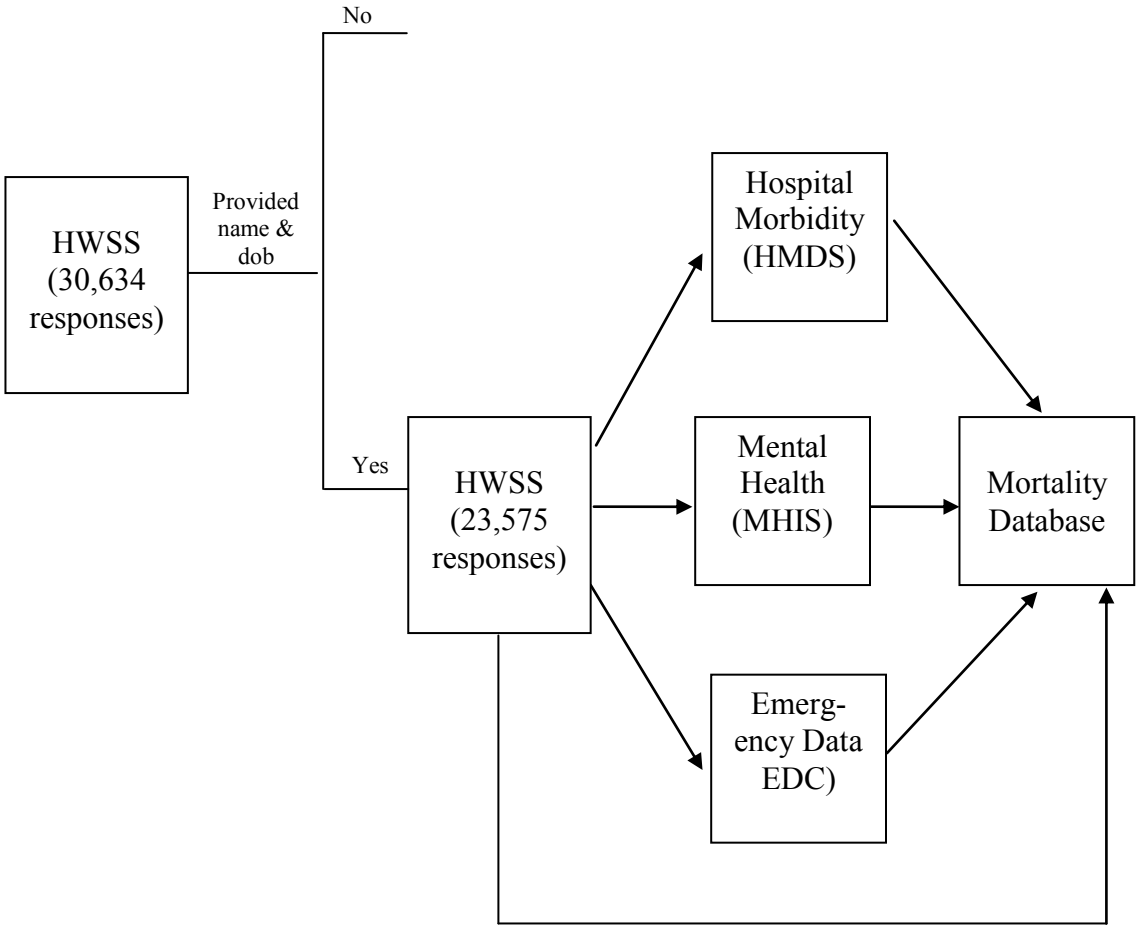


Figure 3.1: Linkage of HWSS responses with other administrative health data sets

3.2.2.1. Hospital Morbidity Database System

The HMDS collects information via the Hospital Inpatient Summary Form, which is completed by hospital staff and coded by experienced coders using the International Statistical Classification of Disease (ICD) (Department of Health Western Australia 2006). The HMDS commenced in 1970 and collects information on in-patients from all public and private hospitals in WA (Department of Health Western Australia 2006). All admissions to hospital between March 2000 and January 2009 that were coded as an intentional cause of injury (ICD-10 codes of X60-84) were linked.

3.2.2.2. Emergency Department Data Collection

The EDDC covers presentations to emergency departments at public hospitals in WA from July 2002 onwards (Department of Health Western Australia 2005b). All presentations during the study period were linked.

3.2.2.3. Mental Health Information System

The MHIS collects information on people who use public mental health services in WA and has been collected since 1966. The MHIS collects information from inpatients and from ambulatory data (non inpatients) (Department of Health Western Australia 2005c). All episodes of mental service use between March 2001 and December 2008 were linked.

3.2.2.4. Mortality Database

The Mortality Database contains information on all deaths registered in Western Australia by the Registrar of Births, Deaths and Marriages since 1969, including information on the Cause of Death (COD). The COD information is coded using the ICD. Due to the possibility of suicides being classified as other causes of death (Australian Bureau of Statistics 2007b), all deaths registered between April 2002 and January 2009 and not just those classified as intentional self harm were linked.

3.3. Material

The questions used in the HWSS were chosen in consultation with experts within the WA DoH, other state Health Departments and external organisations. In 2002 and 2003 the WA DoH, the South Australian Department of Human Services and the New South Wales Department of Health participated in four field tests of questions to be used in surveillance systems as part of the CATI Technical Reference Group (TRG) (National

Computer Assisted Telephone Interview Technical Reference Group 2003a; Computer Assisted Telephone Interview Technical Reference Group 2003b; A. Daly, personal communication 2009). This field testing used a mixed repeated measures study design to determine which of two alternative question wordings was the most appropriate for inclusion in national question modules (National Computer Assisted Telephone Interview Technical Reference Group 2003a). The question wordings that were shown to be reliable and valid were included in the HWSS (Department of Health Western Australia 2005a). The questions used in the suicide module were designed in collaboration with a suicide expert at the WA Telethon Institute for Child Health Research (ICHR) (A Daly, personal communication 2008).

The HWSS was designed and conducted as three slightly different versions of the questionnaire[2]; 1) a young adult version for 16 to 24 year olds, 2) an adult version for 25 to 64 year olds; and 3) an older adult version for 65 year olds and over. These different versions of the questionnaire enabled questions specific to one or more of the age groups to be included. For example, questions regarding employment were not asked of the older adults. The suicide questions were consistent across the age groups.

Suicide ideation was measured using the question:

> "During the past 12 months have you ever seriously thought about ending your own life?"

Suicide-related behaviour was measured via the question:

> "In the past 12 months have you tried to end your own life?"

Respondents were able to answer one of four options: "Yes", "No", "Don't know/Can't remember/Unsure" or "Refused" to these questions. From May 2002 only respondents who answered yes to the suicide ideation were asked the suicide-related behaviour question.

[2] The HWSS did include a fourth child version (15 years and under) that was collected from parents/guardians, but this was outside the scope of this study as it did not cover suicide information.

Other variables collected by the HWSS which were considered in this study included:

- *Socio-demographic variables*: gender, age, marital status, education, employment status, living arrangements, household income, financial situation, geographic area, ATSI status.
- *Chronic conditions*: health status, mental and physical component scores[3], disability, arthritis, heart disease, stroke, cancer, diabetes.
- *Health Service Utilisation within the last year*: mental health services, primary health services.
- *Mental health variables*: psychological distress[4], lack of control over life in general, lack of control over health, lack of control over personal life, stressors in the past 12 months (moving house, burgled, death of someone close, relationship breakdown, serious illness, serious injury, financial hardship), mental health problem.
- *Other variables*: alcohol use, number of groups belong to, suicide attempt by family member in past 12 months, suicide attempt by friend in past 12 months, body mass index.

See Appendix A for the wording of the questions included in this study and WA DoH (2007) for the full 2007 HWSS questionnaire.

3.4. Analysis

3.4.1. Part A – HWSS

Part A involved the analysis of the HWSS data to determine 1) the annual prevalence estimate of both suicide ideation and suicide-related behaviour; 2) whether the prevalence of suicide ideation and suicide-related behaviour has changed over time; and 3) the predictors of suicide ideation and suicide-related behaviour.

[3] These are quality of life measures derived from the SF8 (Quality Metric Incorporated nd).
[4] Measured by the Kessler 10 (Australian Bureau of Statistics 2003).

As the HWSS uses a stratified sampling technique rather than simple random sampling it is regarded as a complex sample survey. While simple random sampling assumes each observation is independent, complex samples, such as stratification, do not. Rather, they adjust for the different probabilities of selection (Berglund nd). Most software packages including SAS and SPSS assume the data has been collected using simple random sampling and as a result under-estimate the variance (Berglund nd). Additional techniques are therefore required when analysing data from a complex sampling design, such as the HWSS. Many statistical packages now have additional modules and techniques, for analysing complex surveys, such as SAS survey procedures and SPSS complex sampling techniques.

3.4.1.1. Data Cleaning

During the study period the HWSS data were received on a monthly basis by the Health Outcomes Assessment Unit (HOAU) within the DoH Epidemiology Branch. Each month the HOAU cleaned the data using standard syntax to verify coding and to derive additional variables. For example, the Kessler 10 instrument consists of ten questions that measure psychological distress (Australian Bureau of Statistics 2003). During the data cleaning process these ten questions were recoded, scored and then categorised into low, moderate, high or very high psychological distress.

As multiple years of data were combined together cross tabulations by year and month were conducted on each variable to ensure the coding and question wording were consistent over time. Response options of don't know/can't remember/unsure and refused were removed from the analysis.

There were seven responses collected between March 2002 and May 2002 where the suicide ideation response was a "no", but the suicide-related behaviour response was a "yes". To ensure consistency these responses were removed as respondents from May 2002 onwards were not asked the suicide attempt question if they had responded "no" to

the ideation question. Valid responses (i.e. a yes or a no) to the suicide questions were given by 30,482 (99.5%) of respondents.

3.4.1.2. Annual estimates

The HWSS is a population based system, so in order for the HWSS responses to reflect those of the WA population the data were weighted to compensate for the over-sampling in the rural and remote areas and then weighted to the age and gender distribution of the WA population using the ABS ERP (Department of Health Western Australia 2005a). To ensure that any potential changes were a result of changes in suicide behaviour and not a result of a change in the age by gender structure of the population, the HWSS data from each year were reweighted to the same reference population, the 2006 ERP (Australian Bureau of Statistics 2007c). Respondents to the HWSS who were not asked questions in the suicide module (and were therefore excluded from this study) were removed prior to the re-weighting.

To take the stratified sampling strategy into account SPSS version 15.1 complex sampling was used for the derivation of the annual estimates (SPSS Inc 2006). As the suicide questions were only asked of young adults (16 to 24 year olds) from March 2002 to August 2003, the analysis was conducted from March 2002 to June 2008 for 16 to 24 year olds and from September 2003 to June 2008 for 16 year olds and over.

Annual population prevalence estimates for each year were derived for these population groups using the complex sampling module, which takes the sample design and weights into account. The different stratification (Area Health Services from 2002 to 2006 and sample area from 2007 onwards) were taken into account in the analysis.

3.4.1.3. Time Series

One of the strengths of the ongoing nature of the HWSS data is the ability to determine if there have been any significant changes in suicide ideation and suicide-related behaviour over time. To determine if there were changes in suicidal behaviour over time the age and gender standardised prevalence of suicide ideation and suicide-related behaviour were derived for each month using SPSS version 15.1 complex sampling and aggregated into a single file. As the HWSS was not collected in July and August 2002; January, July and August 2003 and September and October 2004, missing values were replaced by using the mean of the nearby months. A date variable was defined to identify that each month belonged to a specific year.

For both suicide ideation and suicide-related behaviour linear regression analysis was conducted using the date variable as the independent variable. The Durbin-Watson tests of residuals were obtained and compared to the Durbin-Watson critical value tables for 2 parameters (year and month) (*Durbin-Watson Critical Values* n.d.) to determine if the regression assumption of independence of errors had been violated. Durbin-Watson values that were greater than the upper boundary of the critical table denoted that there was no autocorrelation.

Autoregression analysis was used to determine if there had been a significant change over time. The monthly prevalence estimate was used as the dependent variable and the year and month were included as independent variables.

3.4.1.4. Logistic Regression

There is an ongoing debate regarding whether sampling weights should be used in analytical studies, such as the logistic regression within this study, with two schools of thought (Lee & Forthoefer 2006). The design-based view, which takes the survey design into account, posits that the use of sample weights is essential if the data is not from a simple random sample (Hosmer & Lemeshow 2000; Lee & Forthoefer 2006). The

model-based view holds that the sampling design is not relevant when making inferences from a specified model (Lee & Forthoefer 2006) and so ignores the sample design and statistical weights (Hosmer & Lemeshow 2000). Design-based models are often used when estimating parameters, while model-based designs are used for other functions, such as in determination of linearity for continuous covariates (Hosmer & Lemeshow 2000).

The use of weighted and unweighted estimates can produce different results in regression analysis (Korn & Graubard 1995). Accounting for the sample design and weights in analysis protects against 'the possible misspecification of the population model' (Hosmer & Lemeshow 2000, 76).

As the HWSS uses a stratified sampling strategy, analyses that use the weights and take the sample design into account were considered using SAS v9.1.3. The estimates produced by an unweighted normal logistic regression that included the sample area, age and gender as independent variables was compared with the estimates produced using a weighted SAS surveylogistic procedure that took the sample design into account. For the weighted analysis the entire sample was weighted to the 2006 ERP. As both these analyses produced similar estimates the sample design was considered to be not informative for the model, supporting the use of an unweighted normal logistic regression. Furthermore, the different stratification over the years would complicate any analysis taking the sample design into account. For these reasons, an unweighted normal logistic regression technique was chosen, where variables used in the sampling and weighting (sample area, year, month, age, gender) were included in every regression model, irrespective of significance.

Three separate analyses were conducted using the HWSS data. The first predicted suicidal ideation and used all respondents. The second predicted suicide-related behaviour using all respondents as the sample, while the third predicted suicide-related behaviour using only those respondents who reported suicidal ideation. Separate

analyses were considered for males and females, but instead gender was included in the analyses regardless of whether or not it was significant.

Each variable considered for the logistic regression was inspected by year and month to determine consistency over time. Multicollinearity was assessed for each of the potential independent variables. Any two variables that had a correlation of .4 or higher were entered into a linear regression model to obtain a tolerance value and a variance inflation factor (VIF). Variables with a tolerance of <.2 or a VIF of >5 were regarded as collinear and so only one of these pairs was used in the subsequent analysis. The standard errors were also assessed during the logistic regression.

For each model the initial selection of variables to be entered into the logistic regression was determined by single-predictor analysis of each variable. Continuous variables were grouped into categories for ease of interpretation and to avoid potential problems with linearity of continuous covariates. Single-predictor logistic regressions and cross tabulations were conducted and as suggested by Hosmer and Lemeshow (2000), any variable with a test p-value of <.25 was retained for the multiple-predictor model. Each of the variables identified in the single-predictor analysis was entered into a single model (Hosmer & Lemeshow 2000) using an enter method. From this initial model variables with significant Wald statistics (p<.05) were retained and the model was run again. This step was repeated until a model with only significant variables was found, referred to as the initial model.

Each previously removed variable was then individually re-entered into the model and retained if the Wald statistic was significant (p<.05) (Hosmer & Lemeshow 2000). Variables that did not result in a significant Wald statistic (p>=.05), but produced significant parameter estimates were collapsed by combining the non-significant categories and then re-entered into the model. Models that failed to converge had categories collapsed, or in the validation stage, removed (Allison 2008). Age and gender interactions with each of the variables in the final model were tested. SAS Proc Glimmix

was used to derive odds ratios for variables used in interaction terms (SAS Institute Inc nd).

As the HWSS is a continuous data collection there have been different age groups asked questions and additional questions included over time, such as the 2006 addition of a question asking about whether a family member had attempted suicide. As a result, there were missing responses to some questions within the data set. Missing values were not imputed during this study.

For each model the area under the Receiver Operating Characteristic (ROC curve) was plotted, as were the Pearson and Deviance residuals by the estimated probability. The models were also externally validated against HWSS data collected between July and December 2008. The validation was run as a validation of the associates and of the predictive ability of the model. Binary variables were created for each level of the variables included in the final models. The coefficients from the models were then applied to these variables.

3.4.2. Part B – Linked Data

The health data sets were provided as flat text files containing a linkage person identifier that enabled the multiple data sources to be merged. The text files were imported into SAS, in which the analysis was conducted. With the exception of the Characteristics of linked respondents section, only the HWSS cases that were successfully linked were included in the linked data analysis.

3.4.2.1. Characteristics of linked respondents

To determine if there was a bias in which respondents a) agreed for their HWSS information to be linked to other health data sets and b) were able to be successfully linked, the demographic characteristics of these groups were compared. The HWSS data

set contained a variable denoting whether or not the respondent had agreed for their data to be linked. Using the linkage person identifier provided by the DLU another variable was also created to denote whether or not the linkage had been successful. These two variables were then used in simple cross tabulations of demographic variables, such as gender, age and geographic area. The questions regarding suicide ideation and suicide-related behaviour were also included in these cross tabulations.

However, such a simplistic assessment does not determine statistical significance, nor does it take into account the possible confounding nature of these variables. So, the demographic variables were entered into two logistic regressions to determine what demographic variables were associated with respondents a) agreeing for their information to be linked and b) a successful linkage.

3.4.2.2. Hospital admission records

Between 2000 and 2009 there were 178 hospital admissions for self-harm for the linked study cohort. These hospital admissions related to 119 individuals.

The interview date, self-reported suicide ideation and self-reported suicide-related behaviour from the HWSS were merged with the morbidity information via the linkage person identifier. A date variable was created to denote the number of days between the HWSS interview date and the hospital admission date. This date variable was used to select only the hospital admissions within a year prior to the HWSS interview. The cases were sorted by linkage person identifier and admission date. Cases for the same respondent where the admission date was the same as the separation date were ignored as these would have been hospital transfers. Proc sql commands were used to determine the number of unique linkage person identifiers in the data files.

3.4.2.3. Emergency Department presentations

Between January 2002 and the 24th of July 2009 there were 46,898 ED presentations for any cause for the linked study cohort. These ED presentations related to 12,589 individuals. As there were no records with an intentional self harm ICD-10 code (X60-84) all ED presentations were provided for consideration.

The interview date, self-reported suicide ideation and self-reported suicide-related behaviour from the HWSS were merged with the ED presentation via the linkage person identifier. A date variable was created to denote the number of days between the HWSS interview date and the ED presentation date. This date variable was used to select only the presentations within a year prior to the HWSS interview. As the ED information was only available from January 2002 onwards the data set was limited to select only the HWSS interviews from January 2003 onwards. Proc sql commands were used to determine the number of unique linkage person identifiers in the data files.

3.4.2.4. Deaths

There were 515 deaths from the study cohort. Only the death data with a registration year of 2006 or earlier had a coded cause of death. One hundred and ninety nine of the 515 deaths (38.6%) were coded. The cause of death text was used both to classify the uncoded deaths and to validate the cause of death coding. Deaths that were classified by a coroner as deliberately self inflicted were regarded as a suicide.

The death records were matched to the HWSS records via the linkage person identifier. Respondents were assumed to still be alive if there was no matched death information. A binary variable was created to denote whether or not the respondent had subsequently died. Nine of the 515 deceased had completed two HWSS interviews. These respondents had reported no suicide ideation or suicide-related behaviour on either interview. As the death information was prospective to the HWSS information only the most recent

HWSS interview was retained. A sequence variable was created to identify these cases where the same individual had completed more than one HWSS interview.

Cross tabulations of the binary death variable by suicide ideation and suicide-related behaviour were conducted. To determine if those reporting suicide ideation and/or suicide-related behaviour were more likely to have subsequently died a logistic regression was conducted using the binary death variable as the dependent variable. Gender, age range, suicide ideation and suicide-related behaviour were entered as independent variables.

Survival curves were graphed to determine if there was a significant difference in the survival time of respondents who reported suicide ideation or suicide-related behaviour. Furthermore, Cox proportional hazards regression was used to investigate the effect of variables such as suicide ideation, age, sex, BMI category and general health status.

3.4.2.5. Mental health information

The MHIS data contained multiple records for the same day for people. These same day records could have had similar or different contact types (e.g. family, liaison or clinical), health professional categories (e.g. medical, nursing, undefined), and start and end dates of the episode (referral date and discharge date respectively). The interview date and mental health service use from the HWSS was merged with the MHIS data via the linkage person identifier.

The merged data were imported into SPSS and aggregated so that there was only one record for each day for each person. During this aggregation a variable that denoted the number of different days for which each respondent had clinical MHIS records was created. Only the records with a clinical contact type were retained. The SPSS data file was then saved as a SAS data file and the analysis was performed using SAS.

Only the MHIS records from the year prior to the HWSS interview were retained. To compare the self-reported mental health use from the HWSS with the MHIS a binary variable was created to denote whether or not the respondent had MHIS records. A similar variable already existed on the HWSS file. Each MHIS record for the same person contained the variable denoting the number of different days of clinical MHIS records from the SPSS aggregation. A sequence variable was created on the file to easily identify multiple records for the same person. For this analysis the first record for each person was retained by creating a data set where the sequence variable was equal to one. The MHIS binary variable was cross tabulated with the HWSS binary variable. As the reporting of the MHIS has increased over time this analysis was then repeated by year to determine if the agreement between the MHIS and HWSS was dependent on the year in question.

To compare the number of days of clinical mental health service usage in the MHIS with the self-reported mental health service use in the HWSS only the cases where the binary variables were both yes were retained. The variable denoting the number of different days of clinical MHIS records from the SPSS aggregation was compared with the self-reported times of mental health service use in the last year from the HWSS. A variable was created to denote whether the numbers were the same, whether the HWSS was greater than the MHIS, or whether the MHIS was greater than the HWSS. A frequency of this variable was then run.

To investigate whether those self-reporting mental health service use in the HWSS had non-clinical MHIS contacts the unmatched records were identified (by their missing MHIS contact date). These records were then merged with a file that contained MHIS records that had been aggregated to give the number of records for each contact type on each contact date. The MHIS records that were within the year prior to the HWSS interview were retained and a frequency was run on these records. The unmatched records were also merged with the original MHIS data file as a cross check. This cross check validated the results of the aggregated data file.

The MHIS data were also used to determine the proportion of respondents who reported a suicide-related behaviour in the HWSS and had a clinical MHIS record in the year prior to their interview. The self-reported suicide-related behaviour from the HWSS was merged with the MHIS data file previously created for the comparison of mental health service use. Only the cases that had reported a suicide-related behaviour and had one or more MHIS record were retained. A proc sql command was used to determine the number of unique linkage person identifiers in this data file.

3.4.2.5.1. Hospital Admissions

The file created for the HWSS validation against hospital admission data was used to determine the last MHIS record prior to an admission for self-harm. A sequence variable was created to enable the identification of individuals with repeated hospital admissions. The multiple admission and separation dates were created as separate data sets with renamed variables (e.g. admission2 and separation2). These data sets were then combined into one data set containing a single row for each individual and separate columns for each hospital admission/separation. This data set was then combined with the MHIS data, where only the MHIS records prior to the admission date were retained.

CHAPTER FOUR

RESULTS

4.1. Characteristics of the Sample

Respondents were 30,634 adults aged 16 years and over who completed the HWSS suicide module between March 2002 and June 2008. The respondents who completed the HWSS during the study period, but who were not asked to complete the suicide module were excluded from the analysis.[5]

Table 4.4 shows the unweighted and weighted demographic characteristics of the sample. The major differences between the weighted and unweighted percentages were found in gender, age and location. When compared to the 2006 WA Census results, females were oversampled in the unweighted sample (58.8% compared with 50.2% in the Census (Australian Bureau of Statistics 2008a)), but this was corrected by the weighting. Similarly, while older adults (22.4% compared with 15.1% in the Census (Australian Bureau of Statistics 2008a)) and remote and rural areas were oversampled to ensure large enough numbers for analysis these were adjusted by the weighting. The household income question was the only variable that respondents consistently either did not know or refused to answer. In addition, 4.0% (1,315) of respondents reported being ATSI. While this was higher than the proportion of 15 year olds and over who reported being ATSI in the Census (Australian Bureau of Statistics 2008a), these respondents may not be representative of the ATSI population due to the telephone methodology used.

[5] When the HWSS first started the suicide module was not always asked of adults (25 to 64 year olds) and older adults (65 year olds and over). These responses are therefore missing because they were not asked, rather than respondents refused to answer.

Table 4.4: Demographic characteristics of the sample

	Unweighted %	Weighted %	Number of respondents
Total			30,634
Gender			
Male	41.2	50.3	12,610
Female	58.8	49.7	18,024
Age (a)			
16 to 24 yrs	14.2	19.1	4,351
25 to 64 yrs	63.4	66.9	19,417
65+ yrs	22.4	14.0	6,866
Mean	48.8 yrs	43.4 yrs	
Location			
Metro	40.5	76.0	12,400
Rural	38.4	16.6	11,761
Remote	21.1	7.4	6,473
Education (b)			
Less than yr 10	9.9	6.0	2,954
Year 10 or yr 11	25.6	22.9	7,622
Year 12	14.8	18.0	4,416
Tafe/Trade qual	32.4	31.6	9,656
Tertiary or equivalent	17.2	21.5	5,118
Household income (b)			
Under $20,000	16.2	10.6	4,877
$20,001 to $40,000	18.5	16.1	5,562
$40,001 to $60,000	15.0	16.0	4,501
$60,001 to $80,000	12.3	14.7	3,702
Over $80,000	22.9	25.9	6,876
Don't know (c)	11.5	12.8	3,454
Refused (c)	3.7	4.0	1,114
Marital status (b)			
Married	51.7	54.1	15,850
Living with partner/defacto	8.9	9.5	2,734
Widowed	8.7	3.7	2,672
Divorced	7.2	4.3	2,196
Separated	3.2	2.2	995
Never married	20.1	26.1	6,159
Don't know (c)	0.0	0.0	5
Refused (c)	0.1	0.1	22

(a) Age ranged from 16 to 97 years.

(b) These questions were consistently asked of all respondents from September 2003 onwards. Young adults were asked this question consistently.

(c) These responses were removed from subsequent analyses.

Source: HWSS

Table 4.4: Demographic characteristics of the sample continued

	Unweighted %	Weighted %	Number of respondents
Living arragements (b)			
With parent(s)	9.7	14.4	2,966
With other family	11.5	13.3	3,499
With friends	2.0	3.6	613
With partner and children	40.0	43.9	12,169
With partner and no children	27.2	19.7	8,276
Alone	8.5	4.2	2,592
Other	1.1	0.9	323
Don't know/Refused (c)	0.0	0.0	14
Employment (d)			
Employed	70.0	71.2	17,370
Unemployed	2.6	2.7	642
Home duties	9.2	8.3	2,274
Retired	8.7	5.9	2,157
Unable to work	3.1	2.8	773
Student	6.1	8.8	1,508
Other	0.4	0.4	105
SEIFA (e)			
Quintile 1	18.5	14.8	5,671
Quintile 2	25.1	19.9	7,689
Quintile 3	20.2	19.5	6,201
Quintile 4	20.7	20.4	6,342
Quintile 5	15.4	25.4	4,731
Suicide ideation			
Yes	4.3	4.3	1,316
No (f)	95.2	95.2	29,173
Don't know (c)	0.2	0.2	51
Refused (c)	0.3	0.3	94
Suicide-related behaviour			
Yes (f)	0.6	0.5	172
No	99.4	99.4	30,295
Don't know	0.1	0.1	17
Refused	0.0	0.0	0

(b) These questions were consistently asked of all respondents from September 2003 onwards. Young adults were asked this question consistently.
(c) These responses were removed from subsequent analyses.
(d) Employment status was only asked of 16 to 64 year olds.
(e) Socioeconomic Indicator For Area, where quintile 1 is the most disadvantaged and quintile 5 is the least disadvantaged.
(f) Seven respondents were subsequently removed as they had responded no to ideation and yes to suicide-related suicide-related behaviour. From May 2002 onwards only respondents who answered yes to ideation were asked about suicide-related behaviour.

Source: HWSS

4.2. Time Series

One of the strengths of the HWSS is the ability to analyse whether suicide behaviour has changed over time. During the study period the HWSS data were collected on almost every day of the year and provided to the DoH as monthly data sets. These monthly estimates of suicide behaviour were analysed using time series techniques to determine if the behaviour remained stable over time, known as a stationary series (Pena, Tiao & Tsay 2001). Annual estimates were derived using complex sampling techniques to take the stratified sample design into account. Each year was weighted separately to the age by gender distribution of the WA ERP.

4.2.1. Suicide ideation

Due to the different time lengths that the suicide behaviour was asked, separate time series were analysed for young adults (16 to 24 year olds) and all respondents (16 years and over).

4.2.1.1. Young adults

The annual estimates of suicide ideation for young adults are shown in Table 4.5. These estimates were disaggregated by gender to determine if there was a different trend in suicide ideation in males and females between March 2002 and June 2008.

Female young adults were generally more likely than males to report suicide ideation. Chi square tests confirmed that the prevalence of suicide ideation was significantly higher in females than males in 2002 (12.0% compared to 5.7%, x^2 (1) = 8.5, *OR = 0.4* p=.013), 2004 (12.5% compared to 5.1%, x^2 (1) = 10.4, *OR* = 0.4, p=.012) and 2005 (10.9% compared to 4.3%, x^2 (1) = 12.8, *OR* = 0.4, p=.003).

Among males there were no significant differences between years for suicide ideation. Among females, the prevalence of suicide ideation fluctuated more widely than among

males. The prevalence of suicide ideation among females was significantly higher in 2002 compared to 2007 (12.0% compared to 5.6%, x^2 (1) = 9.9, *OR* = 0.4, *p* =.024) and in 2006 compared to both 2007 and 2008 (16.2% compared to 5.6%, x^2 (1) = 14.3, *OR* = 0.3, *p* = .018 and 16.2% compared to 6.2%, x^2 (1) = 6.9, *OR*=0.3, *p* = .044 respectively). At least part of the fluctuation may be explained by the small sample size.

When males and females were combined, suicide ideation in 2002 was significantly higher compared to 2007 (8.7% compared to 5.1%, x^2 (1) = 7.4, *OR* = 0.6, *p* = .031) and in 2006 compared to 2008 (10.7% compared to 5.1%, x^2 (1) = 9.5, *OR* = 0.4, *p* = .048. However, no consistent trend was evident.

Table 4.5: Annual prevalence estimates of suicide ideation, 16 to 24 year olds, HWSS March 2002 to June 2008

	Males		Females		Persons	
	%	95% CI	%	95% CI	%	95% CI
2002	5.7 *	(3.5 - 9.2)	12.0 *	(8.3 - 16.9)	8.7	(6.5 - 11.6)
2003	6.1	(4.1 - 9.1)	8.9	(6.5 - 12.2)	7.5	(5.8 - 9.6)
2004	5.1 *	(2.8 - 9.0)	12.5 *	(0.6 - 18.9)	8.7	(6.1 - 12.3)
2005	4.3 **	(2.5 - 7.3)	10.9 **	(7.5 - 15.4)	7.5	(5.5 - 10.1)
2006^	5.3	(1.4 - 18.1)	16.2	(7.9 - 30.3)	10.7	(5.7 - 19.3)
2007	4.6	(2.6 - 8.1)	5.6	(3.1 - 9.9)	5.1	(3.4 - 7.6)
2008	7.0	(3.6 - 13.4)	6.2	(3.1 - 11.9)	6.6	(4.1 - 10.5)

^ Note: 2006 has very small numbers as the suicide questions were asked of half the respondents. A parallel version of the General Health Questionnaire was tested during this period.

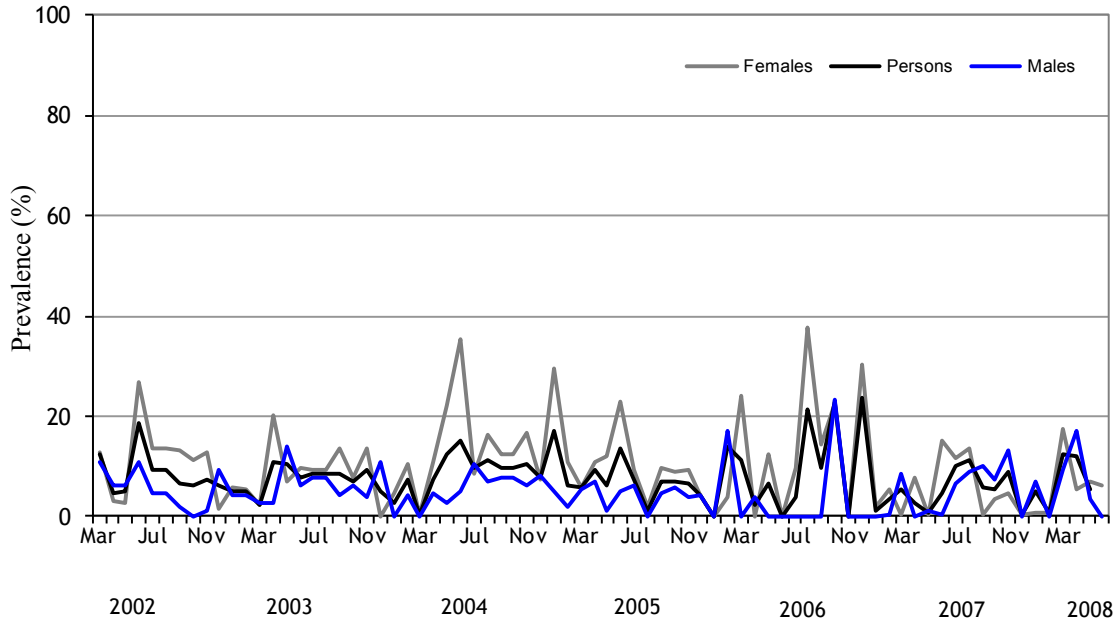
* Males were significantly different from females at p<0.05

** Males were significantly different from females at p<0.01

Source: HWSS

One of the first methods to analyse trends over time is to plot the variable of interest (Brockwell & Davis 2002). Figure 4.2 shows the monthly prevalence estimates of suicide ideation by gender across the study time period. As with the annual prevalence estimates, the monthly estimates fluctuate more widely among females than males. The fluctuations in 2006 may be explained in part by the smaller sample size during this period. Inspection of Figure 4.2 suggests that there may be a decreasing trend for

females, but no change for males or all persons. To assess this interpretation regression functions were conducted on each of the series.



Source: HWSS

Figure 4.2: Time series of suicide ideation, 16 to 24 year olds, HWSS March 2002 to June 2008

To determine if the series exhibited serial autocorrelation a Durbin-Watson test statistic was obtained from a linear regression of suicide ideation for each of the series. When compared to the Durbin-Watson critical tables for the two regressors (year and month), each of the series statistic were above the upper limit of 1.48, denoting that there was no serial autocorrelation at the 1% significance level and that the assumption of independent residuals had not been violated.

The year variable parameter estimates from the autoregression were not significant (p>.05) in each of the suicide ideation series of the young adults, suggesting there was no significant change in the prevalence of suicide ideation between March 2002 and June 2008.

The autocorrelation function (ACF) of the residuals from each of the series was assessed. There were no more than three values outside the confidence limit boundary and there were no large values (all were within +/-0 .4), suggesting they were independent and identically distributed random variables (Brockwell & Davis 2002) and that the series were stationary.

4.2.1.2. All adults

As the suicide module was not asked consistently of all adult respondents until September 2003 a separate time series was created for adults of all ages, limiting the data from September 2003 to June 2008. The annual estimates of suicide ideation for this time period are shown by gender in Table 4.6. In contrast to the young adults, there were no significant differences in the annual estimates between males and females. The annual estimates remained fairly stable across the six years.

Table 4.6: Annual prevalence estimates of suicide ideation, 16 years and over, HWSS September 2003 to June 2008

	Males		Females		Persons	
	%	95% CI	%	95% CI	%	95% CI
2003	4.8	(3.4 - 6.6)	5.4	(4.2 - 7.0)	5.1	(4.1 - 6.3)
2004	3.3	(2.3 - 4.6)	4.5	(3.4 - 6.0)	3.9	(3.1 - 4.9)
2005	3.9	(3.0 - 5.0)	4.7	(3.8 - 5.8)	4.3	(3.6 - 5.1)
2006	4.4	(2.9 - 6.6)	6.2	(4.3 - 8.7)	5.3	(4.0 - 6.9)
2007	2.8	(2.0 - 3.9)	3.8	(3.0 - 4.9)	3.3	(2.7 - 4.0)
2008	3.7	(2.6 - 5.4)	3.4	(2.5 - 4.7)	3.6	(2.8 - 4.5)

Source: HWSS

Plotting the monthly prevalence estimates of suicide ideation by gender across the study time period also suggests that suicide ideation has remained stable over time, as shown in Figure 4.3. As with the young adults, the main fluctuation occurs around 2006, which may be explained by the smaller sample size during this period.

When the Durbin-Watson test statistics for each of the series were compared to the critical tables for the two regressors (year and month), each of the series statistic was above 1.53, denoting that there was no serial autocorrelation at the 1% significance level and that the assumption of independent residuals had not been violated.

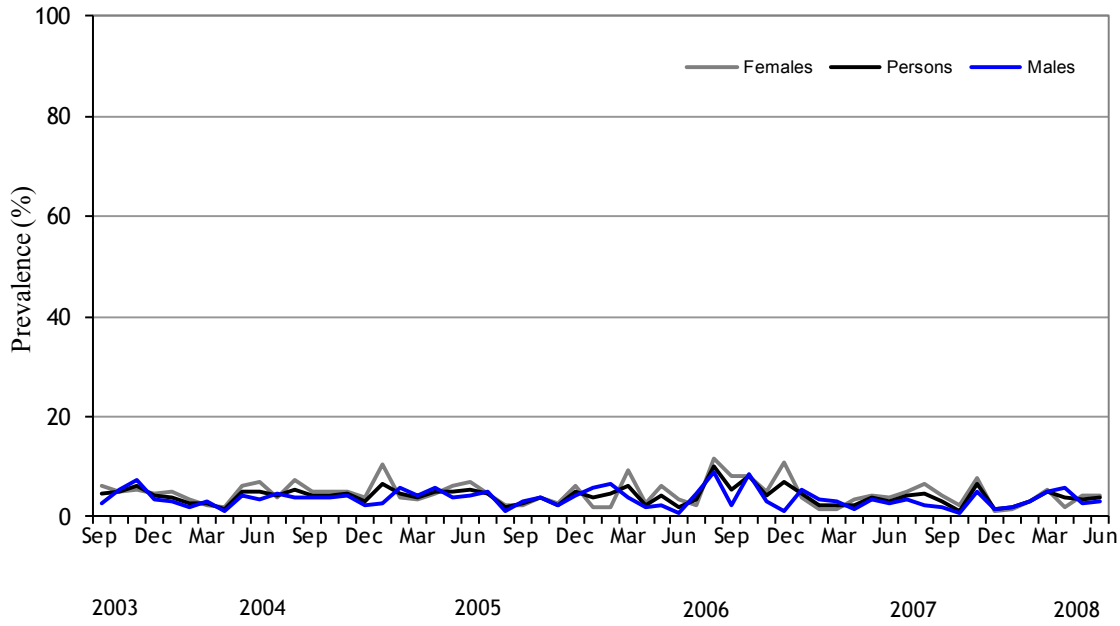


Figure 4.3: Time series of suicide ideation, 16 year olds and over, HWSS September 2003 to June 2008

As with the young adults, each of the year variable parameter estimates from the autoregression were not significant (p>.05). This finding suggests that there was no significant change in the prevalence of suicide ideation in adults aged 16 years and over between September 2003 and June 2008.

The ACF of the residuals from each of the series were assessed. Again, as all but a few of the values fell within the confidence limit boundary and there were no large values (all were within +/-0.5) we can conclude they are independent and identically distributed random variables and that the series are stationary.

4.2.2. Suicide-related behaviour

4.2.2.1. Young adults

The annual estimates of suicide-related behaviour for young adults are shown in Table 4.7. While females were generally more likely than males to report suicide-related behaviour this gender difference was only significant in 2004 (3.1% compared to 0.1%, x^2 (1) = 9.0, *OR* = 0.0, $p<.001$) and in 2006. The small sample size may account for this lack of difference (71 cases among young adults across all years). While there were significant differences in the prevalence of suicide-related behaviour between individual years, there was no trend evident.

Table 4.7: Annual prevalence estimates of suicide-related behaviour, 16 to 24 year old, HWSS March 2002 to June 2008

	Males		Females		Persons	
	%	95% CI	%	95% CI	%	95% CI
2002	0.6	(0.1 - 3.4)	0.8	(0.3 - 2.3)	0.7	(0.3 - 1.8)
2003	1.1	(0.3 - 3.7)	2.9	(1.7 - 4.9)	2.0	(1.2 - 3.3)
2004	0.1 **	(0.0 - 0.4)	3.1 **	(1.3 - 7.0)	1.5	(0.6 - 3.5)
2005	0.4	(0.1 - 1.6)	0.9	(0.4 - 2.0)	0.6	(0.3 - 1.3)
2006^	0.0	(0.0 - 0.0)	1.5	(0.3 - 6.8)	0.8	(0.2 - 3.5)
2007	0.7	(0.2 - 3.0)	1.2	(0.5 - 3.1)	1.0	(0.4 - 2.1)
2008	1.0	(0.2 - 4.3)	1.8	(0.6 - 4.8)	1.4	(0.6 - 3.1)

^ Note: 2006 has very small numbers as the suicide questions were asked of half the respondents. A parallel version of the General Health Questionnaire was tested during this period.

* Males were significantly different from females at p<0.05

** Males were significantly different from females at p<0.01

Plotting the monthly prevalence estimates of suicide-related behaviour across the study time period suggests that suicide-related behaviour among young adults has remained stable over time, as shown in Figure 4.4. Due to the low prevalence of suicide-related behaviour (71 cases in total) the time series information was not disaggregated by gender.

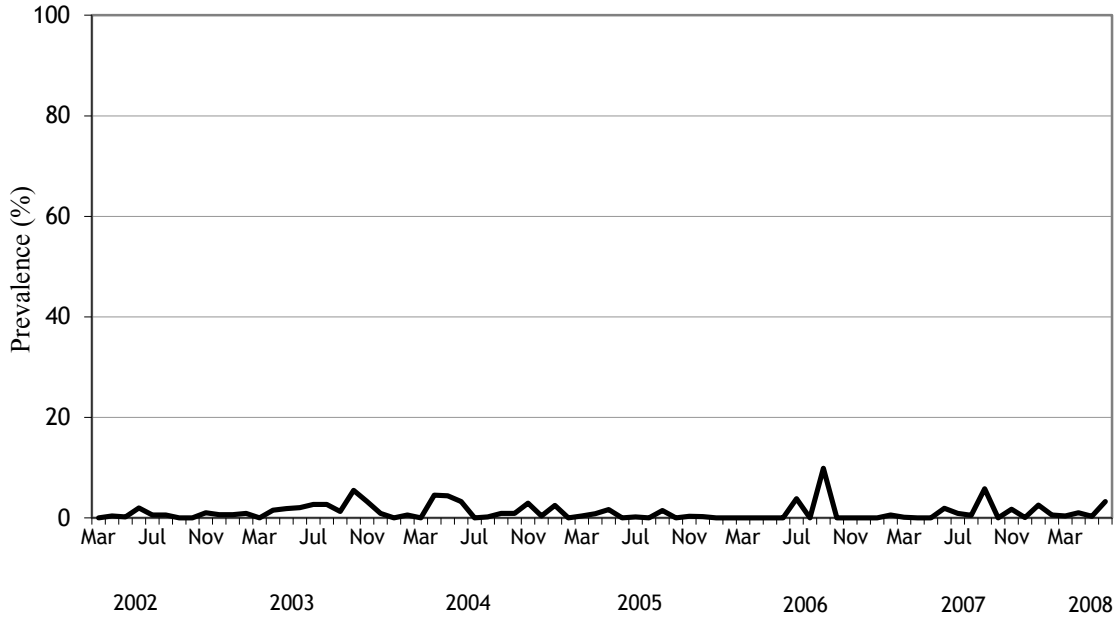


Figure 4.4: Time series of suicide-related behaviour, 16 to 24 year olds, HWSS March 2002 to June 2008

When the Durbin-Watson test statistic was compared to the critical table for the two regressors (year and month), the test statistic was above 1.48, denoting that there was no serial autocorrelation at the 1% significance level and that the assumption of independent residuals had not been violated. The year variable parameter estimate from the autoregression was not significant (p>.05), suggesting there was no significant change in the prevalence of suicide-related behaviour among adults aged to 16 to 24 years between March 2002 and June 2008.

The ACF of the residuals were assessed. As all but one of the values fell within the confidence limit boundary and there were no large values (all were within +/-0.4) we can conclude they are independent and identically distributed random variables and that the series are stationary.

4.2.2.2. All adults

The annual estimates of suicide-related behaviour for all adults aged 16 years and over are shown in Table 4.8. In contrast to the young adults, the prevalence of suicide-related behaviour was generally similar for females and for males. Only in 2008 did females report a significantly higher prevalence of suicide-related behaviour compared to males (0.9% compared to 0.2%, x^2 (1) = 8.4, *OR* = 0.2, p = .025).

Table 4.8: Annual prevalence estimates of suicide-related behaviour, 16 years and over, HWSS September 2003 to June 2008

	Males		Females		Persons	
	%	95% CI	%	95% CI	%	95% CI
2003	0.8	(0.3 - 1.8)	0.8	(0.4 - 1.7)	0.8	(0.5 - 1.4)
2004	0.2	(0.1 - 0.7)	0.7	(0.3 - 1.3)	0.4	(0.2 - 0.8)
2005	0.5	(0.2 - 1.1)	0.5	(0.3 - 0.9)	0.5	(0.3 - 0.8)
2006	0.7	(0.2 - 2.5)	0.6	(0.2 - 1.3)	0.6	(0.3 - 1.4)
2007	0.3	(0.1 - 0.8)	0.4	(0.2 - 0.9)	0.3	(0.2 - 0.6)
2008	0.2 *	(0.1 - 0.7)	0.9 *	(0.5 - 1.8)	0.6	(0.3 - 1.0)

* Males were significantly different from females at p<0.05

As with the young adults, there was no trend in suicide-related behaviour evident from the annual estimates. Plotting the monthly prevalence estimates of suicide-related behaviour across the study time period suggests that suicide-related behaviour among adults aged 16 years and over has also remained stable over time, as shown in Figure 4.5.

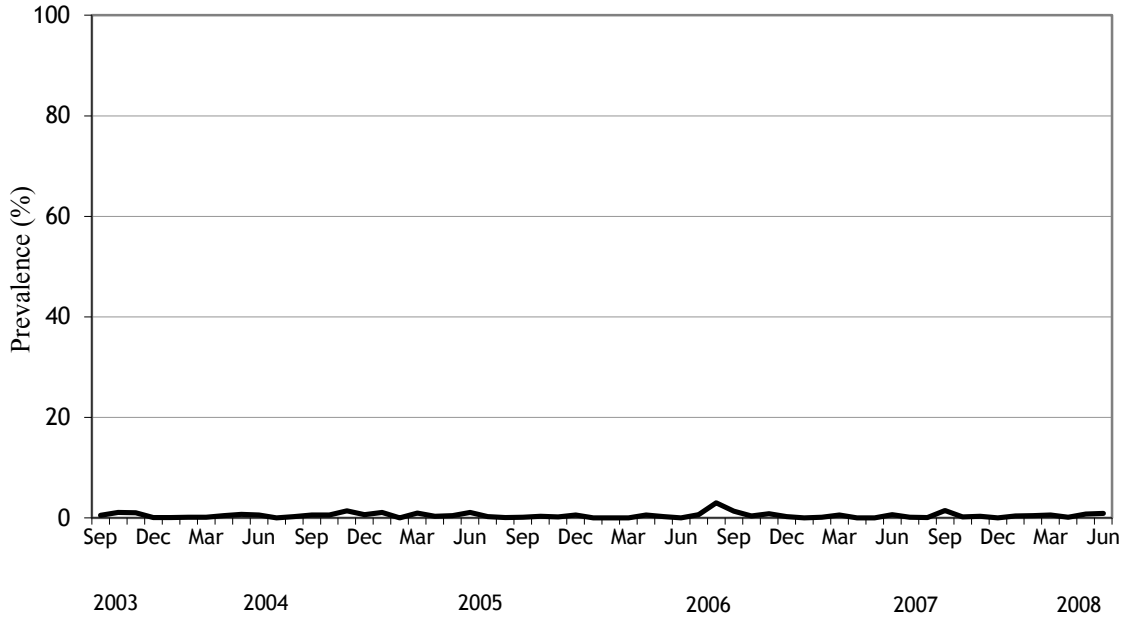


Figure 4.5: Time series of suicide-related behaviour, 16 olds and over, HWSS September 2003 to June 2008

When the Durbin-Watson test statistic was compared to the critical table for the two regressors (year and month), the test statistic was above 1.53, denoting that there was no serial autocorrelation at the 1% significance level and that the assumption of independent residuals had not been violated. The year variable parameter estimate from the autoregression was not significant (p>.05), suggesting there was no significant change in the prevalence of suicide-related behaviour among adults aged 16 years and over between September 2003 and June 2008.

The ACF of the residuals were assessed. As all but two of the values fell within the confidence limit boundary and there were no large values (all were within +/-0.3) we can conclude they are independent and identically distributed random variables and that the series are stationary.

4.3. Logistic regression

4.3.1. Suicide ideation

The variables from the HWSS were used in logistic regression to explore their association and ability to predict suicide ideation. Separate models were not created for each gender, but rather gender was included as a variable in the analysis regardless of whether or not it remained significant.

The regression resulted in several possible models, shown in Table 4.9. Model one was the initial model produced by including all possible independent variables and retaining only the significant ones. Model nine was the final model after all possible variables that had been removed from model one had been re-entered and retained if they were significant. All analyses were adjusted for year, month, geographic area, gender and age to take the sample design into account. Interactions with age range and gender were tested for all variables in the models.

Model nine had the smallest Aikake Information Criteria (AIC) and Schwarz Criteria (SC) and so was selected as the best model. This final model used 21,544 of the 30,634 cases (70%). The missing cases were a result of the dynamic nature of the HWSS, where questions have been added over the years.

The odds ratios of all variables considered in the models and the variables included in the final model are shown in Table 4.10. While drinking at risk/high risk of short-term alcohol use, very severe/severe bodily pain, BMI category were significant in previous models, they were not retained in the final model.

Table 4.9: Possible models for suicide ideation

Model	Variables	# var	AIC	SC	c	sensit-ivity	specif-icity	n
1	gender, age range, geographic area, year, month, current mental health problem, lack of control over health, short term alcohol use, depressed, worthless, BMI category, mental health service use	12	5835.0	6142.9	0.90	20.2	99.4	24,438
2	gender, age range, geographic area, year, month, current mental health problem, lack of control over health, bodily pain, short term alcohol use, depressed, worthless, BMI category, mental health service use	13	5178.6	5515.1	0.90	19.4	99.4	22,278
3	gender, age range, geographic area, year, month, current mental health problem, lack of control over health, bodily pain, short term alcohol use, depressed, worthless, hopeless, BMI category, mental health service use	14	5150.1	5494.6	0.90	19.1	99.4	22,278
4	gender, age range, geographic area, year, month, current mental health problem, lack of control over health, hopelessness, short term alcohol use, depressed, worthless, BMI category, mental health service use, number of different types of life stressors	14	5435.1	5788.8	0.90	20.4	99.4	22,892
5	gender, age range, geographic area, year, month, current mental health problem, lack of control over health, hopelessness, short term alcohol use, depressed, worthless, BMI category, mental health service use, psychological distress, number of different types of life stressors, lack of control over personal life	15	5427.5	5797.3	0.90	19.7	99.4	22,892
6	gender, age range, geographic area, year, month, current mental health problem, lack of control over health, hopelessness, short term alcohol use, depressed, worthless, BMI category, mental health service use, number of different types of life stressors, lack of control over personal life	15	5312.3	5697	0.90	20.6	99.3	22,347

Table 4.9: Possible models for suicide ideation continued

Model	Variables	# var	AIC	SC	c	sensit-ivity	specif-icity	n
7	gender, age range, geographic area, year, month, current mental health problem, hopelessness, depressed, worthless, mental health service use, number of different types of life stressors, lack of control in general, living arrangements	13	5677.5	6041.3	0.90	20.6	99.4	23,937
8	gender, age range, geographic area, year, month, current mental health problem, hopelessness, depressed, worthless, mental health service use, number of different types of life stressors, lack of control in general, living arrangements, lack of control over health, friend attempted suicide	15	5567.8	5963.5	0.90	20.6	99.4	23,761
9	gender, age range, geographic area, year, month, current mental health problem, hopelessness, depressed, worthless, mental health service use, number of different types of life stressors, lack of control in general, living arrangements, lack of control over health, friend attempted suicide, disability	16	4949.7	5348.6	0.90	19.7	99.4	21,544

Table 4.10: Odds ratios of suicide ideation

	Single-predictor (adjusted for year, month and		Multiple-predictor (adjusted for year, month and	
	OR	95% CI	OR	95% CI
Female	1.2 *	(1.0 - 1.3)	0.8 *	(0.7 - 1.0)
Age (ref = 65+)				
16-24 yrs	4.3 ^	(3.5 - 5.3)	2.5 ^	(1.7 - 3.6)
25-44 yrs	2.3 ^	(1.9 - 2.9)	1.4 *	(1.0 - 1.8)
45-64 yrs	2.1 ^	(1.7 - 2.5)	1.4 *	(1.1 - 1.8)
Aboriginal (ref = yes)	0.5 ^	(0.3 - 0.6)	-	- -
Household income (ref = Over $80,000)				
Under $20,000	2.5 ^	(2.0 - 3.0)	-	- -
$20,001 to $40,000	1.5 ^	(1.3 - 1.9)	-	- -
$40,001 to $60,000	1.4 **	(1.1 - 1.7)	-	- -
$60,001 to $80,000	1.0	(0.8 - 1.3)	-	- -
Seifa group (ref = least disadvantaged)				
Quintile 1 (most disadvan.)	1.8 ^	(1.5 - 2.2)	-	- -
Quintile 2	1.5 ^	(1.3 - 1.9)	-	- -
Quintile 3	1.3 *	(1.1 - 1.6)	-	- -
Quintile 4	1.2	(0.9 - 1.4)	-	- -
Household money situation (ref = save a lot)				
Spend more than get	5.8 ^	(4.2 - 7.8)	-	- -
Just enough money	3.7 ^	(2.8 - 4.8)	-	- -
Spend left over money	2.2 ^	(1.6 - 3.0)	-	- -
Save a bit now and then	1.5 **	(1.1 - 1.9)	-	- -
Save regularly	1.0	(0.7 - 1.3)	-	- -
Marital status (ref = never married)				
Married/de facto	0.4 ^	(0.3 - 0.4)	-	- -
Widowed	0.5 ^	(0.4 - 0.6)	-	- -
Divorced/separated	1.3 **	(1.1 - 1.5)	-	- -
Living arrangements (ref = living alone)				
With parents	1.3 *	(1.1 - 1.7)	0.9	(0.6 - 1.4)
With other family members	1.1	(0.8 - 1.3)	0.7 *	(0.5 - 1.0)
With partner & children	0.5 ^	(0.4 - 0.6)	0.5 **	(0.4 - 0.7)
With partner & no children	0.7 ^	(0.6 - 0.9)	0.7 *	(0.5 - 0.9)
Other	1.2	(0.7 - 1.9)	0.8	(0.4 - 1.5)
Education (ref = tertiary education)				
Less than year 10	1.3 *	(1.1 - 1.7)	-	- -
Year 10 or 11	1.5 ^	(1.2 - 1.8)	-	- -
Year 12	1.6 ^	(1.3 - 2.0)	-	- -
Tafe/Trade	1.4 ^	(1.2 - 1.7)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.10: Odds ratios of suicide ideation continued

	Single-predictor (adjusted for year, month and geographic		Multiple-predictor (adjusted for year, month and	
	OR	95% CI	OR	95% CI
Cancer (ref = no)	1.3 *	(1.0 - 1.6)	-	- -
Arthritis (ref = no)	1.2 **	(1.1 - 1.4)	-	- -
Heart disease (ref = no)	1.3 **	(1.1 - 1.6)	-	- -
Disability (ref = no)	2.6 ^	(2.3 - 2.9)	1.3 **	(1.1 - 1.5)
Current mental health problem	9.8 ^	(8.7 - 11.0)	2.3 ^	(1.9 - 2.7)
Lack of control over life in general (ref =never)				
Always	32.9 ^	(25.0 - 43.3)	2.2 **	(1.4 - 3.4)
Often	22.8 ^	(18.8 - 27.7)	2.0 ^	(1.5 - 2.7)
Sometimes	9.4 ^	(8.0 - 11.1)	1.9 ^	(1.5 - 2.4)
Rarely	3.1 ^	(2.6 - 3.7)	1.3 *	(1.0 - 1.7)
Lack of control over personal life (ref = never)				
Always	33.4 ^	(25.3 - 44.1)	-	- -
Often	27.1 ^	(22.4 - 32.9)	-	- -
Sometimes	8.7 ^	(7.5 - 10.2)	-	- -
Rarely	3.1 ^	(2.6 - 3.7)	-	- -
Lack of control over health (ref = never)				
Always/often	11.0 ^	(9.4 - 12.8)	1.5 **	(1.1 - 1.9)
Sometimes	4.3 ^	(3.8 - 5.0)	1.3 *	(1.1 - 1.6)
Rarely	2.2 ^	(1.9 - 2.6)	1.2	(1.0 - 1.6)
Self rated health in general (ref = excellent)				
Poor	8.8 ^	(6.8 - 11.2)	-	- -
Fair	4.1 ^	(3.3 - 5.1)	-	- -
Good	2.1 ^	(1.7 - 2.6)	-	- -
Very good	1.2	(1.0 - 1.5)	-	- -
BMI category (ref = not overweight or obese)				
Obese	1.1	(0.9 - 1.2)	-	- -
Overweight	0.7 ^	(0.6 - 0.8)	-	- -
Bodily pain in last 4 weeks (ref= none)				
Very severe/severe	4.6 ^	(3.8 - 5.6)	-	- -
Moderate	2.7 ^	(2.3 - 3.3)	-	- -
Mild	1.7 ^	(1.5 - 2.1)	-	- -
Very mild	1.2 *	(1.0 - 1.5)	-	- -
Short-term drinking risk (ref = non-drinkers)				
High risk	2.1 ^	(1.7 - 2.7)	-	- -
Risky	1.2 *	(1.0 - 1.5)	-	- -
Low risk	0.7 ^	(0.6 - 0.7)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.10: Odds ratios of suicide ideation continued

	Single-predictor (adjusted for year, month and geographic		Multiple-predictor (adjusted for year, month and	
	OR	95% CI	OR	95% CI
Felt hopeless in last 4 weeks (ref = none of the time)				
All/most of the time	36.9 ^	(30.6 - 44.6)	2.1 ^	(1.5 - 3.0)
Some of the time	13.7 ^	(11.8 - 16.1)	1.6 **	(1.2 - 2.0)
A little of the time	7.1 ^	(6.1 - 8.2)	1.4 **	(1.2 - 1.8)
Felt depressed in last 4 weeks (ref = none of the time)				
All of the time	99.2 ^	(74.6 - 131.8)	4.5 ^	(2.8 - 7.3)
Most of the time	56.0 ^	(45.5 - 69.0)	4.3 ^	(3.0 - 6.0)
Some of the time	18.4 ^	(15.5 - 21.9)	3.8 ^	(3.0 - 5.0)
A little of the time	6.4 ^	(5.4 - 7.6)	2.4 ^	(1.9 - 3.1)
Felt worthless in last 4 weeks (ref = none of the time)				
All/most of the time	41.2 ^	(33.8 - 50.2)	2.8 ^	(2.0 - 4.1)
Some of the time	15.6 ^	(13.3 - 18.4)	2.1 ^	(1.6 - 2.7)
A little of the time	8.8 ^	(7.6 - 10.3)	1.9 ^	(1.5 - 2.4)
Mental health service use (ref= no use)				
13 or more times	24.0 ^	(17.4 - 33.1)	2.5 ^	(1.6 - 4.1)
2 to 12 times	11.4 ^	(9.7 - 13.4)	2.1 ^	(1.6 - 2.6)
1 time	6.3 ^	(4.7 - 8.6)	1.3	(0.9 - 2.1)
Number of different types of stressors (ref = no stressors)				
3 or more	10.9 ^	(9.1 - 13.1)	1.7 ^	(1.4 - 2.2)
2	4.4 ^	(3.7 - 5.3)	1.5 **	(1.2 - 1.9)
1	2.1 ^	(1.8 - 2.6)	1.2	(0.9 - 1.5)
Smokes (ref = non-smokers)	2.5 ^	(2.3 - 2.9)	-	- -
Life stressors in last year (ref = no)				
Moved	2.1 ^	(1.9 - 2.5)	-	- -
Death	1.6 ^	(1.5 - 1.9)	-	- -
Relationship breakup	4.6 ^	(4.0 - 5.2)	-	- -
Financial difficulties	5.7 ^	(5.0 - 6.5)	-	- -
Serious injury	2.5 ^	(2.1 - 3.1)	-	- -
Serious illness	2.7 ^	(2.4 - 3.2)	-	- -
Family member attempted suicide in last year (ref = no)	2.7 ^	(1.9 - 3.8)	-	- -
Friend attempted suicide in last year (ref = no)	3.4 ^	(3.0 - 3.9)	1.6 ^	(1.3 - 1.9)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Single-predictor analysis

Any variable with a *p*-value of <.25 in the single-predictor analysis was considered for the multiple-predictor analysis and is shown in Table 4.10. The *socio-demographic* risk factors for suicide ideation were being female; being aged under 65 years; being an Aboriginal or Torres Strait Islander; having a household income of less than $60,000; being in a disadvantaged SEIFA group; not being in a household situation where money could be saved regularly; being widowed/divorced; living with parent and having an education lower than tertiary. Being married/de facto or widowed was protective.

The *chronic condition* risk factors for suicide ideation were having been ever diagnosed with cancer; arthritis; heart disease; a disability that places a burden on family; experiencing bodily pain in the last four weeks; less than very good self-rated health status and having been diagnosed with depression, anxiety, stress or another mental health problem in the last year (a current mental health problem). The bodily pain and self-rated health status showed a dose response relationship, with the odds of suicide ideation increasing with the severity of pain and the reduction of health status.

The *mental health* risk factors for suicide ideation were feelings of lack of control over one's life in general, personal life and health over the past four weeks; feelings of hopelessness, depression and worthlessness in the past four weeks; use of mental health services; having been effected by a house move, death, relationship breakup, financial difficulties, serious injury or serious illness in the last year (referred to as life stressors); and the number of different types of life stressors. The majority of these mental health variables exhibited a dose response relationship.

The *other* risk factors for suicide ideation were drinking at risky or high risk levels for short term harm[6]; currently smoking; having a family member who attempted suicide in the last year; and having a friend who attempted suicide in the last year. Being overweight was a protective factor.

[6] Based on the 2002 Australian Alcohol guidelines

The mental health risk factors showed the strongest association with suicide ideation. Having felt depressed all of the time in the last four weeks was the strongest risk factor. Respondents who reported this level of depression were 99 times more likely to report suicide ideation than those who reported never having felt depressed in the last 4 weeks. There was also a significant dose response relationship found for this depression variable.

Multiple-predictor analysis

All of the variables shown in the single-predictor analysis were tested in the multiple-predictor model. In the final model only three *socio-demographic* risk factors were included. These risk factors for suicide ideation were being male (in contradiction to the single-predictor analysis); being aged less than 65 years; and living with family members other than parents or living with a partner, which was protective. The remaining variables that were significant in the single-predictor analysis (Aboriginal or Torres Strait Islander status; household income; SEIFA group; household money situation; marital status; and education) were not significant in the multiple-predictor model. Sixteen to 24 year olds were nearly twice as likely to report suicide ideation as 25 year olds and older.

In the final model only two *chronic condition* risk factors were included. These risk factors for suicide ideation were having a disability that places a burden on family; and having been diagnosed with depression, anxiety, stress or other mental health problem in the last year (a current mental health problem). Despite being significant in the single-predictor analysis, having been diagnosed with cancer, arthritis, or heart disease; experiencing bodily pain in the last four weeks; and self-rated health status were not significant in the multiple-predictor model. Having been diagnosed with a current mental health problem doubled the likelihood of reporting suicide ideation.

The majority of *mental health* risk factors remained in the final model, with only lack of control over one's personal life in the past four weeks and the life stressors failing to remain significant. The significant risk factors for suicide ideation when all other variables were controlled were feelings of lack of control over one's life in general, and

over health in the past four weeks; feelings of hopelessness, depression and worthlessness in the past four weeks; use of mental health services; and the number of different types of life stressors (the individual life stressors did not remain). Unlike the single-predictor analysis, having used a mental health service once in the last year was not a significant associate of suicide ideation.

Of the *other* risk factors, only having a friend who attempted suicide in the last year remained in the final model. All other variables failed to remain significant when other variables were controlled.

As in the single-predictor analysis the mental health risk factors showed the strongest association with suicide ideation. Having felt depressed all of the time in the last four weeks remained the strongest risk factor for suicide ideation, but the odds ratio reduced from 99.2 in the single-predictor analysis to 4.5 in the multiple-predictor analysis, highlighting how the addition of other variables can alter the influence of individual variables.

Other than the removal of variables there were some other notable differences between the multiple-predictor and single-predictor results. The same dose response relationships were not found in the multiple-predictor analysis as in the single-predictor analysis. For example, while the odds ratios increased with the frequency of feeling depressed in the last four weeks in both analyses, the confidence intervals overlapped in the multiple-predictor analysis, suggesting that the odds ratios were not significantly different (confidence intervals of 2.8-7.3 for all of the time and 3.0-6.0 for most of the time). Interestingly, while being female was associated with suicide ideation in the single-predictor analysis, being male was associated with ideation in the multiple-predictor analysis. Also, while the individual life stressors did not remain in the final model, the number of different life stressors experienced in the last year was significant.

Bonferonni or similar adjustments were not made to the results (Perneger 1998). The low *p*-values, particularly for the mental health risk factors, mean that these variables would remain significant even if such adjustments were applied.

4.3.1.1. Model performance

The final model (model nine) resulted in a sensitivity of 19.7% and a specificity of 99.4%, giving an area below the ROC curve of .9. As the area below the ROC curve is greater than .9, this suggests that the model has outstanding discriminatory ability (Hosmer & Lemeshow 2000). However, the model gave a Positive Predictive Value (PPV) of only 58.8% and a Negative Predictive Value (NPV) of 96.7% and had a significant Hosmer and Lemeshow Goodness-of-Fit Test (x^2 = 23.8, df = 8, p = .0024), suggesting an inadequate fit of data.

4.3.1.2. Model diagnostics

The Deviance residual by expected probability plot, Pearson residual by expected probability plot, Pearson residual by observation number plot and Deviance residual by observation number were assessed. While the vast majority of residuals were clustered around zero there were a number of observations falling outside the +/2 two range, suggesting that the variability of the data was not adequately described by the data.

4.3.1.3. External validation

The model was validated using subsequent HWSS data collected between July and December 2008.

Associates

To determine if the risk factors remained significant in another sample of respondents the final multiple-predictor model was run using the July to December 2008 data. The model used 2,885 of the 2,938 responses (98.2%). The categories in the mental health service use and feeling depressed in the last four weeks were collapsed due to problems with low numbers in these categories. The results from this validation of the model are shown in Table 4.11.

Table 4.11: Odds ratios of external validation of suicide ideation model

	Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI
Female	1.2	(0.7 - 2.0)
Age (ref = 65+)		
16-24 yrs	5.1 **	(1.5 - 17.4)
25-44 yrs	2.0	(0.9 - 4.6)
45-64 yrs	1.4	(0.7 - 3.0)
Living arrangements (ref = living alone)		
With parents	0.7	(0.2 - 2.4)
With other family members/friends	1.8	(0.8 - 4.1)
With partner & children	0.8	(0.4 - 1.7)
With partner & no children	0.9	(0.4 - 1.7)
Other	0.6	(0.1 - 3.2)
Disability (ref = no)	0.8	(0.5 - 1.3)
Current mental health problem (ref = no)	3.9 ^	(2.3 - 6.6)
Lack of control over life in general (ref =never)		
Always	3.1	(0.8 - 11.8)
Often	1.8	(0.7 - 4.7)
Sometimes	1.7	(0.8 - 3.4)
Rarely	1.7	(0.8 - 3.5)
Lack of control over health (ref = never)		
Always/often	1.5	(0.7 - 3.2)
Sometimes	1.2	(0.6 - 2.4)
Rarely	0.7	(0.3 - 1.6)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.11: Odds ratios of external validation of suicide ideation model continued

	Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI
Felt hopeless in last 4 weeks (ref = none of the time)		
All/most of the time	1.9	(0.7 - 5.7)
Some of the time	1.9	(0.9 - 4.0)
A little of the time	1.6	(0.8 - 3.2)
Felt depressed in last 4 weeks (ref = none of the time)		
All or most of the time	3.7 *	(1.3 - 10.3)
Some of the time	3.4 **	(1.6 - 7.1)
A little of the time	2.1 *	(1.0 - 4.2)
Felt worthless in last 4 weeks (ref = none of the time)		
All/most of the time	4.3 **	(1.5 - 12.5)
Some of the time	2.6 *	(1.2 - 5.4)
A little of the time	1.4	(0.7 - 2.9)
Mental health service use (ref= no use)		
2 or more times	2.3 *	(1.2 - 4.4)
1 time	3.7 *	(1.3 - 10.7)
Number of different types of stressors (ref = no stressors)		
3 or more	1.2	(0.6 - 2.5)
2	1.1	(0.6 - 2.3)
1	1.2	(0.6 - 2.3)
Friend attempted suicide in last year (ref = no)	1.8	(0.7 - 4.2)

**p*<.05 (Chi square) ***p*<.01 (Chi square) ^*p*<.0001 (Chi square)

The only variables that remained significant in the validation model were being aged 16 to 24 years; having been diagnosed with depression, anxiety, stress or another mental health problem in the last year (current mental health problem); feeling depressed, worthless in the last four weeks; and mental health service use. All the other variables that were significant in the model building process (gender; living arrangements; disability; lack of control over one's life in general, health in the last four weeks; feeling hopeless in the last four weeks; number of different types of stressors, having a friend who had attempted suicide in the last year) failed to remain significant.

The validation model resulted in a sensitivity of 23.9% and a specificity of 99.0%, giving an area below the ROC curve of .9. The model resulted in a non-significant Hosmer and Lemeshow Goodness-of-Fit Test (x^2=8.0, *df*=8, *p*=.4320), suggesting an adequate fit of the data.

Prediction

To determine the predictive ability of the model the regression equation was applied to the June to December 2008 data. This equation is shown in Appendix B (A). The model resulted in ideation predictions for 2,911 of the 2,938 responses (99.1%). The missing 27 cases were due to responses of 'can't remember/don't know/unsure' or 'refused' to questions that were included in the model.

The model predicted 54 cases of suicide ideation, 22 of which were validated by the suicide ideation responses to the HWSS. The model correctly predicted only 22 of the 120 cases of suicide ideation, resulting in a sensitivity of only 18.3%. The specificity of the model performed much better than the sensitivity, correctly predicting no ideation for 2,757 of the 2,783 cases, giving a specificity of 99.1%. The Positive Predictive Value (PPV) of the model was 45.8%, while the Negative Predictive Value (NPV) was 96.6%. Of interest was the prediction of six of the 'can't remember/don't know/unsure' or 'refused' responses as having ideation.

4.3.2. Suicide-related behaviour (all respondents)

The variables from the HWSS were used in a logistic regression to explore their ability to predict suicide-related behaviour. Separate models were created using all respondents and only those respondents who reported suicide ideation.

The regression resulted in several possible models, shown in Table 4.12. Model one was the initial model produced by including all possible independent variables and retaining only the significant ones. Model five was the final model after all possible variables that had been removed from model one had been re-entered and retained if they were significant. All analyses were adjusted for year, month, geographic area, gender and age

to take the sample design into account. Interactions with age range and gender were tested for all variables in the models.

Model five had the smallest Aikake Information Criteria (AIC) and so was selected as the best model. This final model used only 9,863 of the 30,634 cases (32%). The majority of the missing cases were because the question regarding whether or not a family member had attempted suicide in the past year was only added to the HWSS in 2006. As model five was restricted to only responses collected from 2006 onwards, model three was also considered.

The odds ratios of all variables considered in the models and the variables included in the final model are shown in Table 4.13. The odds ratios of model three are shown in Appendix C.

Table 4.12: Possible models for suicide-related behaviour (all respondents)

Model	Variables	# var	AIC	SC	c	sensit-ivity	specif-icity	n
1	geographic area, year, month, gender, age range, curent mental health problem, BMI category, depressed, worthless, short term alcohol use, mental health service use, seriously injured in last year	12	821.7	1107.6	0.96	10.1	100	20,776
2	geographic area, year, month, gender, age range, curent mental health problem, BMI category, depressed, worthless, mental health service use, seriously injured in last year, number of different types of life stressors	12	823.8	1101.9	0.95	9.0	99.9	20,872
3	geographic area, year, month, gender, age range, curent mental health problem, BMI category, depressed, worthless, mental health service use, seriously injured in last year, number of different types of life stressors, smokes	13	821.4	1107.4	0.96	8.0	99.9	20,868
4	geographic area, year, month, gender, age range, curent mental health problem, worthless, mental health service use, seriously injured in last year, smokes, family member attempted suicide	11	407.1	615.8	0.94	13.0	99.9	9,863
5	geographic area, year, month, gender, age range, curent mental health problem, worthless, mental health service use, seriously injured in last year, smokes, family member attempted suicide, gender by seriously injured in last year	12	401.4	617.3	0.94	10.9	100	9,863

Table 4.13: Odds ratios for suicide-related behaviour (all respondents)

	Single-predictor (adjusted for year, month and geographic		Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI	OR	95% CI
Female	1.7 **	(1.2 - 2.4)	3.4 *	(1.1 - 10.4)
Age (ref = 65+)				
16-24 yrs	10.1 ^	(5.3 - 19.3)	8.1 **	(2.4 - 27.1)
25-44 yrs	3.2 **	(1.7 - 6.3)	1.1	(0.3 - 3.8)
45-64 yrs	2.1 *	(1.1 - 4.1)	0.8	(0.2 - 2.8)
Aboriginal (ref = yes)	0.4 **	(0.2 - 0.8)	-	- -
Household income (ref = Over $80,000)				
Under $20,000	3.8 ^	(2.2 - 6.4)	-	- -
$20,001 to $40,000	1.5	(0.8 - 2.8)	-	- -
$40,001 to $60,000	1.5	(0.8 - 2.7)	-	- -
$60,001 to $80,000	0.5	(0.2 - 1.3)	-	- -
Seifa group (ref = least disadvantaged)				
Quintile 1 (most disadvan.)	3.3 **	(1.7 - 6.6)	-	- -
Quintile 2	2.9 **	(1.4 - 5.7)	-	- -
Quintile 3	2.8 **	(1.4 - 5.6)	-	- -
Quintile 4	2.2 *	(1.1 - 4.4)	-	- -
Household money situation (ref = save a lot)				
Spend more than get	3.6 **	(1.7 - 7.6)	-	- -
Just enough money	2.8 **	(1.5 - 5.1)	-	- -
Spend left over money	1.4	(0.6 - 3.1)	-	- -
Save a bit now and then	1.0	(0.5 - 1.9)	-	- -
Save regularly	0.5	(0.3 - 1.1)	-	- -
Marital status (ref = never married)				
Married/de facto	0.2 ^	(0.1 - 0.3)	-	- -
Widowed	0.2 ^	(0.1 - 0.4)	-	- -
Divorced/separated	0.7	(0.4 - 1.0)	-	- -
Living arrangements (ref = living alone)				
With parents	3.3 **	(1.6 - 6.5)	-	- -
With other family members	1.3	(0.6 - 2.8)	-	- -
With partner & children	0.4 *	(0.2 - 0.8)	-	- -
With partner & no children	1.1	(0.5 - 2.1)	-	- -
Other	2.5	(0.8 - 8.0)	-	- -
Education (ref = tertiary education)				
Less than year 10	2.0	(1.0 - 4.3)	-	- -
Year 10 or 11	2.7 **	(1.5 - 4.9)	-	- -
Year 12	2.4 **	(1.3 - 4.5)	-	- -
Tafe/Trade	1.9 *	(1.1 - 3.5)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.13: Odds ratios for suicide-related behaviour (all respondents) continued

	Single-predictor (adjusted for year, month and geographic		Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI	OR	95% CI
Cancer (ref = no)	1.7	(1.0 - 2.8)	-	- -
Stroke (ref = no)	1.7	(0.7 - 3.8)	-	- -
Disability (ref = no)	2.8 ^	(2.0 - 3.9)	-	- -
Current mental health problem	18.2 ^	(12.8 - 26.0)	9.1 ^	(3.8 - 21.8)
Belong to one or more group	0.5 ^	(0.3 - 0.7)	-	- -
Lack of control over life in general (ref =never)				
Always	38.8 ^	(21.2 - 71.0)	-	- -
Often	19.2 ^	(11.4 - 32.3)	-	- -
Sometimes	9.5 ^	(6.1 - 14.8)	-	- -
Rarely	2.7 **	(1.6 - 4.6)	-	- -
Lack of control over personal life (ref = never)				
Always	41.4 ^	(23.3 - 73.8)	-	- -
Often	25.5 ^	(15.7 - 41.3)	-	- -
Sometimes	7.5 ^	(4.8 - 11.6)	-	- -
Rarely	3.0 ^	(1.8 - 5.0)	-	- -
Lack of control over health (ref = never)				
Always/often	13.6 ^	(9.1 - 20.4)	-	- -
Sometimes	4.2 ^	(2.7 - 6.5)	-	- -
Rarely	2.3 **	(1.4 - 3.8)	-	- -
Self rated health in general (ref = excellent)				
Poor	10.7 ^	(5.4 - 21.1)	-	- -
Fair	5.3 ^	(2.8 - 10.0)	-	- -
Good	2.3 *	(1.3 - 4.3)	-	- -
Very good	1.0	(0.5 - 2.0)	-	- -
BMI category (ref = not overweight or obese)				
Obese	0.6	(0.4 - 1.0)	-	- -
Overweight	0.5 **	(0.3 - 0.7)	-	- -
Bodily pain in last 4 weeks (ref= none)				
Very severe/severe	4.2 ^	(2.5 - 7.0)	-	- -
Moderate	3.1 ^	(1.9 - 4.9)	-	- -
Mild	1.3	(0.8 - 2.2)	-	- -
Very mild	1.5	(0.9 - 2.5)	-	- -
Short-term drinking risk (ref = non-drinkers)				
High risk	2.8 ^	(1.7 - 4.6)	-	- -
Risky	1.3	(0.8 - 2.2)	-	- -
Low risk	0.5 **	(0.3 - 0.7)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.13: Odds ratios for suicide-related behaviour (all respondents) continued

	Single-predictor (adjusted for year, month and geographic		Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI	OR	95% CI
Felt hopeless in last 4 weeks (ref = none of the time)				
All/most of the time	58.7 ^	(38.2 - 90.2)	-	- -
Some of the time	16.4 ^	(10.5 - 25.5)	-	- -
A little of the time	7.5 ^	(4.7 - 11.8)	-	- -
Felt depressed in last 4 weeks (ref = none of the time)				
All of the time	159.4 ^	(90.6 - 280.7)	-	- -
Most of the time	69.6 ^	(41.0 - 118.2)	-	- -
Some of the time	15.3 ^	(9.0 - 26.0)	-	- -
A little of the time	5.4 ^	(3.1 - 9.4)	-	- -
Felt worthless in last 4 weeks (ref = none of the time)				
All/most of the time	70.3 ^	(46.1 - 107.1)	9.2 ^	(3.4 - 24.8)
Some of the time	22.6 ^	(14.7 - 34.8)	6.4 ^	(2.6 - 15.3)
A little of the time	9.5 ^	(6.0 - 15.2)	2.6	(0.9 - 7.2)
Mental health service use (ref= no use)				
13 or more times	72.8 ^	(45.1 - 117.7)	9.0 **	(2.9 - 27.6)
2 to 12 times	17.6 ^	(12.0 - 26.0)	2.5 *	(1.1 - 5.7)
1 time	7.7 ^	(3.5 - 16.9)	0.6	(0.1 - 5.0)
Number of different types of stressors (ref = no stressors)				
3 or more	27.0 ^	(14.8 - 49.5)	-	- -
2	9.0 ^	(4.8 - 16.9)	-	- -
1	3.0 **	(1.6 - 5.8)	-	- -
Smokes (ref = non-smokers)	3.4 ^	(2.5 - 4.6)	2.8 **	(1.4 - 5.6)
Life stressors in last year (ref = no)				
Moved	3.3 ^	(2.3 - 4.7)	-	- -
Death	2.0 ^	(1.5 - 2.9)	-	- -
Relationship breakup	6.7 ^	(4.7 - 9.4)	-	- -
Financial difficulties	7.3 ^	(5.1 - 10.3)	-	- -
Serious injury	5.5 ^	(3.7 - 8.3)	12.9 **	(3.2 - 51.5)
Serious illness	4.0 ^	(2.7 - 5.7)	-	- -
Family member attempted suicide in last year (ref = no)	4.5 ^	(2.1 - 9.5)	3.6 **	(1.4 - 9.1)
Friend attempted suicide in last year (ref = no)	4.3 ^	(3.0 - 6.1)	-	- -
Interaction of sex with serious injury (ref=no injury)				
Female with serious injury	-	- -	1.1	(0.4 - 3.3)
Male with serious injury	-	- -	12.9 **	(3.2 - 51.5)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Single-predictor analysis

In the single-predictor analysis the *socio-demographic* risk factors for suicide-related behaviour were being female; being aged under 65 years; being an Aboriginal or Torres Strait Islander; having a household income of less than $20,000; being in a disadvantaged SEIFA group; being in a household situation where there is no left over or saved money; being married/de facto; living with parents; and having an education lower than tertiary, but year 10 or higher. Being widowed was protective, but this may have been related to the older age of these respondents.

The significant *chronic condition* risk factors for suicide-related behaviour were having a disability that places a burden on family; experiencing severe bodily pain in the last four weeks; less than very good self-rated health status and having been diagnosed with depression, anxiety, stress or other mental health problem in the last year (a current mental health problem). Having been ever diagnosed with cancer, or a stroke had a *p*-value of less than .25 so were considered in the multiple-predictor analysis, but were not significant in the single-predictor analysis.

The *mental health* risk factors for suicide-related behaviour were feelings of lack of control over one's life in general, personal life and health over the past four weeks; feelings of hopelessness, depression and worthlessness in the past four weeks; use of mental health services; having been effected by a house move, death, relationship breakup, financial difficulties, serious injury or serious illness in the last year; and the number of different types of life stressors. The majority of these mental health variables exhibited a dose response relationship, where the odds ratios increased significantly with the frequency of the variable.

The *other* risk factors for suicide-related behaviour were drinking at high risk levels for short term harm[7]; currently smoking; having a family member who attempted suicide in the last year; having a friend who attempted suicide in the last year; and being overweight. Belonging to one or more group was a protective factor.

[7] Based on the 2002 Australian Alcohol guidelines

As with suicide ideation, the mental health risk factors showed the strongest association with suicide-related behaviour. Having felt depressed all of the time in the last four weeks was the strongest risk factor. Respondents who reported this level of depression were 159 times more likely to report suicide-related behaviour than those who reported never having felt depressed in the last 4 weeks. There was also a significant dose response relationship found for this depression variable.

Multiple-predictor analysis

All of the variables shown in the single-predictor analysis were tested in the multiple-predictor model. In the final model only two *socio-demographic* risk factors were included. These risk factors were being female and being aged between 16 and 24. The remaining variables that were significant in the single-predictor analysis (Aboriginal or Torres Strait Islander status; household income; SEIFA group; household money situation; marital status; living arrangements and education) were not significant in the multiple-predictor model. Sixteen to 24 year olds were more than eight times as likely to report suicide-related behaviour as 65 year olds and older.

In the final model only one *chronic condition* risk factor was included - having been diagnosed with depression, anxiety, stress or other mental health problem in the last year (a current mental health problem). Despite being significant in the single-predictor analysis, having been diagnosed with cancer, stroke, BMI categories, experiencing bodily pain in the last four weeks; and self-rated health status were not significant in the multiple-predictor model. Having been diagnosed with a current mental health problem resulted in a nine fold increase in the likelihood of reporting suicide-related behaviour.

Unlike the final suicide ideation model, the majority of mental health risk factors did not remain in the final model. Only having been diagnosed with depression, anxiety, stress or another mental health problem in the last year (a current mental health problem), mental health service use and feelings of worthlessness in the last 4 weeks remained significant. While feelings of depression were the strongest association in the single-predictor analysis, this was not significant when all other variables were included in the analysis.

Of the *other* risk factors, only having a family member who attempted suicide in the last year remained in the final model. All other variables failed to remain significant when other variables were controlled.

Bonferonni or similar adjustments were not made to the results (Perneger 1998). The low *p*-values, particularly for the mental health risk factors, mean that these variables would remain significant even if such adjustments were applied.

4.3.2.1. Model performance

Model five resulted in a sensitivity of 10.9% and a specificity of 100%, giving an area below the ROC curve of .94. As the area below the ROC curve is greater than .90, this suggests that the model has outstanding discriminatory ability (Hosmer & Lemeshow 2000). The model also had a non-significant Hosmer and Lemeshow Goodness-of-Fit Test ($x^2 = 5.7$, $df = 8$, $p = .679$), which suggests an adequate fit of data. However, as the model gave a Positive Predictive Value (PPV) of only 55.6%, a Negative Predictive Value (NPV) of 99.6% its discriminatory ability was limited in identifying suicide-related behaviours.

4.3.2.2. Model diagnostics

Several model diagnostic plots were assessed; the Deviance residual by expected probability plot, the Pearson residual by expected probability plot, the Pearson residual by observation number and the Deviance residual by observation number. While the vast majority of residuals were clustered around zero there were a number of observations falling outside the +/2 two range, suggesting that the variability of the data was not adequately described by the data.

4.3.2.3. External validation

The model was validated using subsequent HWSS data collected between July and December 2008.

Associates

To determine if the risk factors remained significant in another sample of respondents the final multiple-predictor model was run using the July to December 2008 data. Due to the model not converging the categories of the mental health service use variable were collapsed as were July and August. The sex by injury interaction term was removed as the respondents who had reported an injury and a suicide-related behaviour were male, resulting in a quasi-complete separation. The results from this validation of the model are shown in Table 4.14.

The only variables that remained significant in the validation model were having been diagnosed with depression, anxiety, stress or another mental health problem in the last year (current mental health problem); feeling worthless in the last four weeks; being a current smoker and having a family member who attempted suicide in the last year. All the other variables that were significant in the model building process (gender; age group; mental health service use and life stressors) failed to remain significant.

Prediction

To determine the predictive ability of the model developed the regression equation was applied to the June to December 2008 data. This equation is shown in Appendix B (B). The model resulted in suicide-related behaviour predictions for 2,915 of the 2,938 responses (99.2%). The missing 23 cases were due to responses of 'can't remember/don't know/unsure' or 'refused' to questions that were included in the model.

Table 4.14: Odds ratios of external validation of suicide-related behaviour model (all respondents)

	Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI
Female	1.2	(0.2 - 6.8)
Age (ref = 65+)		
16-24 yrs	2.1	(0.1 - 43.2)
25-44 yrs	1.2	(0.1 - 14.4)
45-64 yrs	0.6	(0.1 - 7.6)
Current mental health problem	6.1 *	(1.0 - 37.0)
Felt worthless in last 4 weeks (ref = none of the time		
All/most of the time	18.6 **	(1.9 - 182.4)
Some of the time	10.6 *	(1.5 - 77.0)
A little of the time	9.6 *	(1.1 - 88.1)
Mental health service use (ref= no use)		
1 or more time	2.9	(0.5 - 17.5)
Smokes (ref = non-smokers)	5.0 *	(1.0 - 24.6)
Life stressors in last year (ref = no)		
Serious injury	4.0	(0.6 - 26.8)
Family member attempted suicide in last year (ref = no)	7.6 *	(1.0 - 55.6)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

The model predicted 26 cases of suicide-related behaviour, none of which were validated by responses to the HWSS. The model performed poorly, failing to correctly predict any of the nine cases of self-reported suicide-related behaviour, resulting in a sensitivity of 0%. The specificity of the model performed much better than the sensitivity, correctly predicting no suicide-related behaviour for 2,880 of the 2,906 cases, giving a specificity of 99.1%. The model had no Positive Predictive Value (PPV), while the Negative Predictive Value (NPV) was 99.7%.

Model three was also validated against the July to December 2008 HWSS data. This model resulted in suicide-related behaviour predictions for 2,607 of the 2,938 responses (88.7%). The majority of cases that were removed were due to missing information for

height and weight measurements used to derive the BMI category. The alternative model also performed poorly, failing to correctly predict any of the eight cases of self-reported suicide-related behaviour, resulting in a sensitivity of 0%. The specificity of the model was 99.9%. The model had no Positive Predictive Value (PPV), while the Negative Predictive Value (NPV) was 99.7%.

4.3.3. Suicide-related behaviour (respondents who reported ideation)

The variables from the HWSS were used in logistic regression to explore their ability to predict suicide-related behaviour. The regression resulted in several possible models, shown in Table 4.15. Model one was the initial model produced by including all possible independent variables and retaining only the significant ones. Model two was the final model after all possible variables that had been removed from model one had been re-entered and retained if they were significant. All analyses were adjusted for year, month, geographic area, gender and age to take the sample design into account. Interactions with age range and gender were tested for all variables in the models.

Model two had the smallest Aikake Information Criteria (AIC) and the greatest area under the ROC curve (c) and so was selected as the best model. This final model used only 921 of the 1,316 cases (70%). The majority of the missing cases were a result of the dynamic nature of the HWSS, where questions have been added over the years. The odds ratios of all variables considered in the models and the variables included in the final model are shown in Table 4.16.

Single-predictor analysis

Among respondents who reported suicide ideation the significant *socio-demographic* risk factors were being female; being aged 16 to 24 years; not being in a household situation where money could be saved regularly; marital status other than never married and living with parents. Being married/de facto, widowed, divorced/separated was a protective factor.

The *chronic condition* risk factors for suicide ideation were having been ever diagnosed with heart disease and having been diagnosed with depression, anxiety, stress or other mental health problem in the last year (a current mental health problem).

The *mental health* risk factors for suicide ideation were feelings of lack of control over one's personal life over the past four weeks; feelings of hopelessness, depression and worthlessness in the past four weeks; use of mental health services; having been effected by the type and number of life stressors. The majority of these mental health variables exhibited a dose response relationship.

The *other* risk factors were being overweight or obese and currently smoking. Interestingly being overweight or obese was a protective factor.

Table 4.15: Possible models for suicide-related behaviour (respondents reporting ideation)

Model	Variables	# var	AIC	SC	c	sensit-ivity	specif-icity	n
1	geographic area, year, month, gender, age range, BMI category, mental health service use, seriously injured, worthless	9	604.8	739.9	0.81	13.5	98.0	921
2	geographic area, year, month, gender, age range, BMI category, mental health service use, seriously injured, worthless, smokes	10	602.9	742.9	0.81	12.6	98.1	921

Table 4.16: Single-predictor and multiple-predictor odds ratios for suicide-related behaviour (model two)

	Single-predictor (adjusted for year, month and		Multiple-predictor (adjusted for year, month and	
	OR	95% CI	OR	95% CI
Female	1.6 **	(1.1 - 2.3)	1.4	(0.8 - 2.3)
Age (ref = 65+)				
16-24 yrs	3.1 **	(1.5 - 6.1)	2.5 *	(1.0 - 5.9)
25-44 yrs	1.5	(0.8 - 3.1)	1.1	(0.5 - 2.8)
45-64 yrs	1.0	(0.5 - 2.1)	0.9	(0.4 - 2.1)
Household income (ref = Over $80,000)				
Under $20,000	1.6	(0.9 - 2.9)	-	- -
$20,001 to $40,000	1.0	(0.5 - 1.9)	-	- -
$40,001 to $60,000	1.1	(0.6 - 2.1)	-	- -
$60,001 to $80,000	0.5	(0.2 - 1.3)	-	- -
Seifa group (ref = least disadvantaged)				
Quintile 1 (most disadvan.)	2.0	(1.0 - 4.2)	-	- -
Quintile 2	2.0	(1.0 - 4.2)	-	- -
Quintile 3	2.4 *	(1.2 - 5.0)	-	- -
Quintile 4	2.0	(1.0 - 4.3)	-	- -
Marital status (ref = never married)				
Married/de facto	0.4 ^	(0.3 - 0.6)	-	- -
Widowed	0.4 *	(0.2 - 0.8)	-	- -
Divorced/separated	0.5 **	(0.3 - 0.8)	-	- -
Living arrangements (ref = living alone)				
With parents	2.8 **	(1.4 - 5.9)	-	- -
With other family members/friends	1.3	(0.6 - 2.8)	-	- -
With partner & children	0.8	(0.4 - 1.8)	-	- -
With partner & no children	1.6	(0.8 - 3.3)	-	- -
Other	2.4	(0.7 - 8.4)	-	- -
Education (ref = tertiary education)				
Less than year 10	1.6	(0.7 - 3.4)	-	- -
Year 10 or 11	2.0 *	(1.1 - 3.8)	-	- -
Year 12	1.6	(0.8 - 3.2)	-	- -
Tafe/Trade	1.4	(0.8 - 2.7)	-	- -
Arthritis (ref = no)	0.7	(0.5 - 0.5	-	- -
Heart disease (ref = no)	0.5 *	(0.2 - 1.0)	-	- -
Current mental health problem (ref = no)	2.5 ^	(1.7 - 3.6)	-	- -
Belong to 1 group or more (ref = no)	0.7	(0.5 - 1.0)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.16: Single-predictor and multiple-predictor odds ratios for suicide-related behaviour (model two) continued

	Single-predictor (adjusted for year, month and geographic		Multiple-predictor (adjusted for year, month and	
	OR	95% CI	OR	95% CI
Lack of control over personal life (ref = never)				
Always	1.9 **	(1.0 - 3.5)	-	- -
Often	1.3	(0.8 - 2.3)	-	- -
Sometimes	1.0	(0.6 - 1.5)	-	- -
Rarely	1.0	(0.6 - 1.7)	-	- -
Lack of control over health (ref = never)				
Always/often	1.5	(1.0 - 2.3)	-	- -
Sometimes	1.0	(0.6 - 1.6)	-	- -
Rarely	1.0	(0.6 - 1.8)	-	- -
BMI category (ref = not overweight or obese)				
Obese	0.5 **	(0.3 - 0.9)	0.4 **	(0.2 - 0.7)
Overweight	0.6 **	(0.4 - 0.9)	0.7	(0.4 - 1.1)
Short-term drinking risk (ref = non-drinkers)				
High risk	1.5	(0.8 - 2.6)	-	- -
Risky	1.1	(0.6 - 1.9)	-	- -
Low risk	0.7	(0.5 - 1.0)	-	- -
Felt hopeless in last 4 weeks (ref = none of the time)				
All/most of the time	2.7 ^	(1.7 - 4.3)	-	- -
Some of the time	1.5	(0.9 - 2.4)	-	- -
A little of the time	1.2	(0.7 - 1.9)	-	- -
Felt depressed in last 4 weeks (ref = none of the time)				
All of the time	3.4 ^	(1.9 - 6.3)	-	- -
Most of the time	1.9 *	(1.1 - 3.4)	-	- -
Some of the time	0.9	(0.5 - 1.6)	-	- -
A little of the time	0.8	(0.5 - 1.5)	-	- -
Felt worthless in last 4 weeks (ref = none of the time)				
All/most of the time	3.3 ^	(2.1 - 5.2)	3.0 **	(1.6 - 5.5)
Some of the time	1.9 **	(1.2 - 3.1)	2.0 *	(1.1 - 3.7)
A little of the time	1.2	(0.8 - 2.0)	0.8	(0.4 - 1.6)
Mental health service use (ref= no use)				
13 or more times	6.4 ^	(3.7 - 11.1)	9.1 ^	(4.5 - 18.3)
2 to 12 times	2.1 **	(1.4 - 3.2)	2.3 **	(1.3 - 3.9)
1 time	1.4	(0.6 - 3.3)	1.0	(0.3 - 3.1)
Number of different types of stressors (ref = no stressors)				
3 or more	3.3 **	(1.8 - 6.2)	-	- -
2	2.5 **	(1.3 - 4.8)	-	- -
1	1.5	(0.7 - 2.9)	-	- -
Smokes (ref = non-smokers)	1.4 *	(1.0 - 2.0)	1.6 *	(1.0 - 2.6)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.16: Single-predictor and multiple-predictor odds ratios for suicide-related behaviour (model two) continued

	Single-predictor (adjusted for year, month and geographic		Multiple-predictor (adjusted for year, month and	
	OR	95% CI	OR	95% CI
Life stressors in last year (ref = no)				
Moved	1.8 **	(1.2 - 2.7)	-	- -
Death	1.4	(0.9 - 2.0)	-	- -
Relationship breakup	1.8 **	(1.2 - 2.6)	-	- -
Financial difficulties	1.5 *	(1.0 - 2.2)	-	- -
Serious injury	2.7 ^	(1.7 - 4.2)	2.8 **	(1.6 - 4.9)
Serious illness	1.6 *	(1.1 - 2.4)	-	- -
Family member attempted suicide in last year (ref = no)	2.0	(0.9 - 4.7)	-	- -
Friend attempted suicide in last year (ref = no)	1.4	(1.0 - 2.1)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Multiple-predictor analysis

All of the variables shown in the single-predictor analysis were tested in the multiple-predictor model. In the final model the only *socio-demographic* risk factor to remain significant was being aged 16 to 24 years.

Interestingly none of the *chronic condition* risk factors remained including having been diagnosed with depression, anxiety, stress or other mental health problem in the last year (a current mental health problem). Of the *mental health* risk factors only feelings of worthlessness; mental health service use and serious injury in the last year remained significant when all other variables were controlled. Having used mental health services 13 times or more in the last year had the strongest association. Of the *other* risk factors, only being obese and currently smoking remained in the final model, with being obese acting as a protective factor.

Bonferonni or similar adjustments were not made to the results (Perneger 1998). The low *p*-values, particularly for the mental health risk factors, mean that these variables would remain significant even if such adjustments were applied.

4.3.3.1. Model performance

Model two resulted in a sensitivity of 12.6% and a specificity of 98.1%, giving an area below the ROC curve of .8. As the area below the ROC curve is between .8 and .9, this suggests that the model has excellent discriminatory ability (Hosmer & Lemeshow 2000). While the model had a non-significant Hosmer and Lemeshow Goodness-of-Fit Test ($x^2 = 7.3$, $df = 8$, $p = .504$), which suggests an adequate fit of data, the model gave a Positive Predictive Value (PPV) of only 48.3%, a Negative Predictive Value (NPV) of 89.1%.

4.3.3.2. Model diagnostics

Several model diagnostic plots were assessed; the Deviance residual by expected probability plot, the Pearson residual by expected probability plot, the Pearson residual by observation number and the Deviance residual by observation number. While the vast majority of residuals were clustered around zero there were a number of observations falling outside the +/2 two range, suggesting that the variability of the data was not adequately described by the data.

4.3.3.3. External validation

To determine if the risk factors remained significant in another sample of respondents the final multiple-predictor model was run using the July to December 2008 data. Due to the model not converging the categories of the mental health service use variable were collapsed, as were July and August.

Associates

The model used 2,885 of the 2,938 responses (98.2%). The results from this validation of the model are shown in Table 4.17. None of the variables remained significant in the validation model, bringing into question the variables found to be significant in the model development stage.

Table 4.17: Odds ratios of external validation of suicide-related behaviour model (respondents reporting ideation)

	Multiple-predictor (adjusted for year, month and geographic area)	
	OR	95% CI
Female	1.3	(0.1 - 10.8)
Age (ref = 65+)		
16-24 yrs	0.9	(0.0 - 32.2)
25-44 yrs	0.5	(0.0 - 8.7)
45-64 yrs	0.5	(0.0 - 7.1)
BMI category (ref = not overweight or obese)		
Obese	1.3	(0.2 - 11.9)
Overweight	0.3	(0.0 - 3.6)
Felt worthless in last 4 weeks (ref = none of the time)		
All/most of the time	1.5	(0.1 - 22.8)
Some of the time	1.1	(0.1 - 12.5)
A little of the time	4.9	(0.4 - 58.1)
Mental health service use (ref= no use)		
1 or more time	2.4	(0.2 - 28.3)
Smokes (ref = non-smokers)	3.8	(0.6 - 25.4)
Life stressors in last year (ref = no)		
Serious injury	2.1	(0.3 - 16.5)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

The equation used for the model is shown in Appendix B (C). The model resulted in suicide-related behaviour predictions for 111 of the 122 responses (99.2%) with suicide ideation. The missing 11 cases were due to responses of 'can't remember/don't know/unsure' or 'refused' to questions that were included in the model.

The model predicted two cases of suicide-related behaviour, none of which were validated by responses to the HWSS. The model performed poorly, failing to correctly predict any of the eight cases of suicide-related behaviour, resulting in a sensitivity of 0%. The specificity of the model performed much better than the sensitivity, correctly predicting no suicide-related behaviour for 101 of the 109 cases, giving a specificity of 98.1%. The model had no Positive Predictive Value (PPV), while the Negative Predictive Value (NPV) was 92.7%.

4.4. Linked data

4.4.1. Characteristics of respondents who agreed to linkage

Of the 30,634 respondents who completed the suicide module in the HWSS between March 2002 and June 2008, 23,575 (77.0%) agreed for their information to be linked to other health data sets. Of these, 22,666 (96.1%) were successfully linked.

Table 4.18 shows a comparison of the demographic characteristics of those who did, versus did not agree for their information to be linked, as well as a comparison of those whose information was, versus was not successfully linked. Based on the percentages alone the following characteristics were associated with an increased likelihood of agreeing for their information to be linked: being male (x^2 (1) = 40.3, *OR* = 1.2, p<.001); being older (x^2 (1) = 26.4, *OR* = 1.3, p<.001 for 65 year olds and over compared with 16 to 24 year olds); living in a rural area (x^2 (1) = 8.3, *OR* = 1.1, p =.004 compared with the metro area); having a TAFE/trade qualification (x^2 (1) = 4.7, *OR* = 1.1, p = .030 compared with less than year 10, which was the closest percentage); being married or divorced (x^2 (1) = 5.4, *OR* = 1.1, p = .020 compared with widowed, which was the closest percentage) and living alone (x^2 (1) = 5.6, *OR* = 1.1, p=.020 compared with living with a partner and no children, which was the closest percentage). There was no significant difference between respondents who reported a suicide-related behaviour compared with no such behaviour (x^2 (1) = 3.7, *OR* = 0.7, p = .055). Respondents who answered "Don't know" or "Refused" to questions were less likely to agree to the linkage.

Table 4.18: Demographic characteristics of the respondents agreeing to linkage

	Agreed to linkage			Matched in linkage		
	Yes	No	# Resp-ondents	Yes	No	# Resp-ondents
Year						
2002	77.3%	22.7%	3,214	96.3%	3.7%	2,485
2003	79.0%	21.0%	3,335	95.5%	4.6%	2,636
2004	62.4%	37.6%	4,540	96.4%	3.6%	2,831
2005	77.5%	22.5%	6,600	96.4%	3.6%	5,116
2006	80.5%	19.6%	2,680	97.8%	2.2%	2,156
2007	82.0%	18.0%	6,540	96.0%	4.1%	5,361
2008	80.3%	19.7%	3,725	95.0%	5.0%	2,990
Gender						
Male	78.8%	21.2%	12,610	95.5%	4.5%	9,936
Female	75.7%	24.3%	18,024	96.6%	3.4%	13,639
Age (a)						
16 to 24 yrs	75.8%	24.2%	4,351	93.5%	6.5%	3,297
25 to 44 yrs	75.7%	24.3%	8,090	94.9%	5.1%	6,123
45 to 64 yrs	76.5%	23.5%	11,327	96.7%	3.3%	8,668
65+ yrs	79.9%	20.1%	6,866	98.2%	1.8%	5,487
Mean	49.2 yrs	47.7 yrs	30,634	49.4 yrs	41.5 yrs	23,575
Location						
Metro	76.4%	23.6%	12,400	96.0%	4.0%	9,474
Rural	77.9%	22.1%	13,813	97.3%	2.7%	10,757
Remote	75.6%	24.4%	4,421	93.0%	7.0%	3,344
Education (b)						
Less than yr 10	76.6%	23.4%	2,954	97.3%	2.7%	2,262
Year 10 or yr 11	76.3%	23.8%	7,622	96.6%	3.4%	5,812
Year 12	75.6%	24.4%	4,416	95.5%	4.5%	3,339
TAFE/Trade qual	78.5%	21.5%	9,656	96.2%	3.8%	7,584
Tertiary or equivalent	75.9%	24.1%	5,118	95.1%	4.9%	3,883
Marital status (b)						
Married	78.3%	21.7%	15,850	96.8%	3.2%	12,405
Living with partner/defacto	75.1%	25.0%	2,734	94.5%	5.5%	2,052
Widowed	76.2%	23.8%	2,672	98.0%	2.0%	2,036
Divorced	78.0%	22.0%	2,196	96.6%	3.4%	1,712
Separated	75.1%	24.9%	995	96.8%	3.2%	747
Never married	74.9%	25.1%	6,159	94.0%	6.0%	4,612
Don't know/Refused (c)	37.0%	63.0%	27	90.0%	10.0%	10
Household income (b)						
Under $20,000	78.7%	21.3%	4,877	97.2%	2.8%	3,839
$20,001 to $40,000	78.4%	21.6%	5,562	96.9%	3.1%	4,361
$40,001 to $60,000	78.7%	21.3%	4,501	96.0%	4.0%	3,544
$60,001 to $80,000	79.7%	20.3%	3,702	95.8%	4.2%	2,949
Over $80,000	81.0%	19.0%	6,876	95.4%	4.6%	5,569
Don't know (c)	69.1%	30.9%	3,454	95.1%	4.9%	2,388
Refused (c)	43.5%	56.5%	1,114	96.3%	3.7%	485

Table 4.18: Demographic characteristics of the respondents agreeing to linkage

	Agreed to linkage			Matched in linkage		
	Yes	No	# Resp-ondents	Yes	No	# Resp-ondents
Living arragements (b)						
With parent(s)	77.8%	22.5%	2,966	95.4%	4.6%	2,306
With other family	72.5%	27.5%	3,499	96.6%	3.4%	2,538
With friends	68.8%	31.2%	613	87.2%	12.8%	422
With partner and children	76.9%	23.1%	12,169	96.2%	3.8%	9,363
With partner and no children	78.1%	21.9%	8,276	96.6%	3.4%	6,466
Alone	80.3%	19.7%	2,592	96.8%	3.2%	2,082
Other	77.7%	22.3%	323	95.6%	4.4%	251
Don't know/Refused (c)	14.3%	85.7%	14	0.0%	100%	<5
Employment (d)						
Employed	76.6%	23.4%	17,370	95.5%	4.5%	13,307
Unemployed	65.1%	34.9%	642	94.7%	5.3%	418
Home duties	75.2%	24.9%	2,274	97.2%	2.8%	1,709
Retired	79.1%	20.9%	2,157	97.5%	2.5%	1,707
Unable to work	70.9%	29.1%	773	97.6%	2.4%	548
Student	78.2%	21.8%	1,508	92.2%	7.8%	1,179
Other	77.1%	22.9%	105	91.4%	8.6%	81
SEIFA (e)						
Quintile 1	76.8%	23.2%	5,671	96.1%	3.9%	4,355
Quintile 2	77.2%	22.9%	7,689	96.6%	3.4%	5,932
Quintile 3	77.3%	22.7%	6,201	96.2%	3.8%	4,791
Quintile 4	76.8%	23.2%	6,342	95.6%	4.4%	4,871
Quintile 5	76.6%	23.4%	4,731	96.1%	3.9%	3,626
Suicide ideation						
Yes	76.1%	23.9%	1,316	96.3%	3.7%	1,002
No (f)	77.2%	22.8%	29,166	96.1%	3.9%	22,528
Don't know (c)	39.2%	60.8%	51	100%	0.0%	20
Refused (c)	20.2%	79.8%	94	100%	0.0%	19
Suicide-related behaviour						
Yes (f)	70.9%	29.1%	165	93.2%	6.8%	117
No	77.2%	22.8%	30,295	96.2%	3.9%	23,398
Don't know	29.4%	70.6%	17	100%	0.0%	5
Refused	0.0%	0.0%	0	0.0%	0.0%	0

(a) Age ranged from 16 to 97 years.

(b) These questions were consistently asked of all respondents from September 2003 onwards. Young adults were asked this question consistently.

(c) These responses were removed from subsequent analyses.

(d) Employment status was only asked of 16 to 64 year olds.

(e) Socioeconomic Indicator For Area, where quintile 1 is the most disadvantaged and quintile 5 is the least disadvantaged.

(f) Seven respondents were removed as they had responded no to ideation and yes to suicide-related suicide-related behaviour. From May 2002 onwards only respondents who answered yes to ideation were asked about suicide-related behaviour.

Based on the percentages alone the following characteristics were associated with an increased likelihood of a successful linkage: being female (x^2 (1) = 18.6, *OR* = 1.3, $p<.001$); being older (x^2 (1) = 131.6, *OR* = 3.8, $p<.001$ for 65 year olds and over compared with 16 to 24 year olds); living in a rural area (x^2 (1) = 26.8, *OR* = 1.5, $p = .043$ compared with the metro area) and being widowed (x^2 (1) = 8.4, *OR*=1.6, $p = .004$ compared with married, which was the closest percentage). There was no significant difference found between respondents who reported a suicide-related behaviour compared with no such behaviour (x^2 (1) = 2.9, *OR* = 0.5, $p = .087$).

However, such a simplistic assessment does not take into account the possible confounding nature of these variables. For example, marital status is likely to be associated with age. The demographic variables in Table 4.18 were entered into two logistic regressions to determine which demographic variables were associated with respondents a) agreeing for their information to be linked and b) a successful linkage.

Employment status was not entered into the logistic regression as this variable was only collected from adults under the age of 65. Suicide-related behaviour was entered into the model, but was not significant. When all other variables were entered into the logistic regression, all variables except for SEIFA and marital status were significantly associated with agreeing for information to be linked, as shown in Table 4.19.

The following variables were associated with a significantly higher likelihood of agreeing to the linkage; being male; being older; living in a rural, but not remote area; having a household income of more than $80,001; living with parents, or with a partner and children; and having a Year 10/11 or a TAFE/trade qualification. In contrast, responding with “Don’t know” or “Refused” to the suicide ideation or the household income question was associated with a significantly lower likelihood of agreeing to the linkage. There was also a significant age by sex interaction. Males aged 45 years and over were significantly more likely to agree for their information to be linked compared with females of the same age.

Table 4.19: Logistic regression of linkage

	Agreement to link		Successfully linked	
	OR	95% CI	OR	95% CI
Year (ref = 2008)				
2002	0.9 *	(0.8 - 1.0)	1.9 ^	(1.4 - 2.5)
2003	0.9	(0.8 - 1.1)	1.6 **	(1.2 - 2.0)
2004	0.4 ^	(0.4 - 0.4)	1.7 **	(1.3 - 2.2)
2005	0.8 **	(0.8 - 0.9)	1.6 **	(1.3 - 2.0)
2006	1.0	(0.9 - 1.2)	2.4 ^	(1.7 - 3.4)
2007	1.1 **	(1.0 - 1.3)	1.5 **	(1.2 - 1.8)
Female	0.5 ^	(0.4 - 0.6)	0.6 *	(0.4 - 0.9)
Age (ref=65+)				
16-24 yrs	0.5 ^	(0.5 - 0.6)	0.1 ^	(0.1 - 0.2)
25-44 yrs	0.7 ^	(0.6 - 0.8)	0.2 ^	(0.1 - 0.3)
45-64 yrs	0.7 ^	(0.6 - 0.8)	0.4 ^	(0.3 - 0.6)
Geographic area (ref = rest of state)				
Metro	0.9 ^	(0.8 - 0.9)	0.7 ^	(0.6 - 0.8)
Kimberley/Pilbara	0.8 ^	(0.7 - 0.9)	0.5 ^	(0.4 - 0.6)
Household income (ref = Over $80,000)				
Under $20,000	0.8 **	(0.7 - 0.9)	-	- -
$20,001 to $40,000	0.8 **	(0.7 - 0.9)	-	- -
$40,001 to $60,000	0.9 *	(0.8 - 1.0)	-	- -
$60,001 to $80,000	0.9	(0.9 - 1.0)	-	- -
Don't know (c)	0.5 ^	(0.5 - 0.6)	-	- -
Refused (c)	0.2 ^	(0.2 - 0.2)	-	- -
Marital status (ref = never married)				
Married/de facto	-	- -	1.5 *	(1.1 - 2.0)
Other	-	- -	1.2	(0.9 - 1.6)
Living arrangements (ref = living alone)				
With parents	1.6 ^	(1.3 - 1.9)	2.0 **	(1.3 - 3.0)
With other family members	1.0	(0.9 - 1.2)	1.1	(0.8 - 1.6)
With other friends	0.9	(0.7 - 1.1)	0.5 **	(0.3 - 0.7)
With partner & children	1.2 **	(1.1 - 1.4)	0.7	(0.5 - 1.0)
With partner & no children	1.1	(1.0 - 1.3)	0.8	(0.6 - 1.1)
Other	1.1	(0.8 - 1.5)	0.7	(0.3 - 1.3)
Don't know/Refused (c)	0.2 *	(0.0 - 0.8)		
Education (ref = tertiary education)				
Less than year 10	1.0	(0.9 - 1.2)	-	- -
Year 10 or 11	1.1 **	(1.0 - 1.2)	-	- -
Year 12	1.1	(1.0 - 1.2)	-	- -
TAFE/Trade	1.1 *	(1.0 - 1.2)	-	- -
Suicide ideation in last year (ref = yes)				
No	1.0	(0.9 - 1.2)	-	- -
Don't know (c)	0.3 ^	(0.2 - 0.6)	-	- -
Refused (c)	0.1 ^	(0.1 - 0.2)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table 4.19: Logistic regression of linkage continued

	Agreement to link			Successfully linked		
	OR	95% CI		OR	95% CI	
Age by sex interaction (ref=male)						
16-24 yrs female	1.0	(0.9 - 1.2)		1.6	**	(1.2 - 2.2)
25-44 yrs female	1.0	(0.9 - 1.1)		1.9	^	(1.5 - 2.4)
45-64 yrs female	0.8	^ (0.7 - 0.9)		1.1		(0.8 - 1.4)
65+ yrs female	0.7	^ (0.6 - 0.8)		0.6	*	(0.4 - 0.9)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

When the demographic variables were entered into a logistic regression to predict successful linkage, only year of the interview, gender, age, geographic area, marital status and living arrangements remained significant, as shown in Table 4.19.

Compared with 2008, having been interviewed in any other year significantly increased the odds of a respondent being successfully linked. As the address was provided along with name and date of birth for the linkage this finding may have been related to the increased likelihood of addresses to be outdated by 2008 given the 2004 EWP sampling frame. The following variables were associated with an increased likelihood of successful linkage; being male; being older; living in the rural, but not remote area; being married or in a de facto relationship; and living with parents. Living with other friends was significantly associated with a lower odds of a successful linkage.

There was also a significant age by sex interaction. Females in the 16 to 24 years and 25 to 44 year age groups were significantly more likely to be successfully linked compared with males of the same age. In contrast, females aged 65 years and over were significantly less likely to be successfully linked compared with their male counterparts. Of particular note is that without the sex by age interaction females rather than males had an increased likelihood of being successfully linked. Education, household income and SEIFA group were not significantly associated.

The linking process revealed instances where the same person had been interviewed more than once. Respondents were eligible to be re-selected for the HWSS one year

after their previous random selection. There were 22,042 people who accounted for the 22,666 HWSS interviews that were linked: 21,434 people completed one interview, 593 people completed two interviews, 14 people completed three interviews and fewer than five[8] people completed four interviews. Just over one in ten respondents (11.7%) who completed two interviews were from the Perth metropolitan area. The people who completed more than two interviews were all from the non-metropolitan region.

4.4.2. Linkage in this study

Of the 22,666 HWSS respondents who were successfully linked to other health data sets, only 13,247 (58.4%) had one or more linked records in this study. The remaining 9,419 HWSS respondents would have had a record outside of the scope of this study (e.g. a hospital admission for something other than intentional self-harm) or would have been linked to data sets outside the scope of this study, such as birth or marriage records.

For this study the information regarding hospital admissions, Emergency Department presentations and mental health service contacts were in reference to the year prior to the HWSS interview. As the linked data were obtained for the entire study period there may have been records that occurred more than a year prior to, or after an individual's HWSS interview. In which case, these records were out of scope.

During the study period there were 165 respondents who reported having attempted to take their own life in the past 12 months. An additional 17 respondents reported being unsure or not able to remember when asked this question (see Table 4.18). Of these 182 respondents, 122 (67.4%) agreed for their HWSS information to be linked to other health data sets. One hundred and fourteen respondents (93.4%) were successfully linked. The demographic characteristics of all respondents who reported suicide-related behaviour compared with those who were able to be linked are shown in Table 4.20.

[8] Cases with fewer than five have not been reported to ensure confidentiality, as per DoH guidelines

Table 4.20: Comparison of demographic characteristics of respondents reporting suicide-related behaviour

	All Respondents	Suicide-related behaviour	
		HWSS	Linked
Gender			
Male	41.2%	29.7%	26.3%
Female	58.8%	70.3%	73.7%
Age			
16 to 24 yrs	14.2%	39.6%	46.5%
25 to 44 yrs	26.4%	28.0%	26.3%
45 to 64 yrs	36.7%	24.2%	18.4%
65+ yrs	22.4%	8.2%	8.8%
Location			
Metro	40.5%	39.6%	37.7%
Rural	45.1%	17.6%	17.5%
Remote	14.4%	42.9%	44.7%
Education			
Less than yr 10	9.9%	9.1%	12.6%
Year 10 or yr 11	25.6%	33.1%	31.5%
Year 12	14.8%	18.3%	18.0%
TAFE/Trade qual	32.4%	29.1%	29.7%
Tertiary or equivalent	17.2%	10.3%	8.1%
Marital status			
Married	51.7%	18.1%	16.7%
Living with partner/defacto	8.9%	10.4%	12.3%
Widowed	8.7%	4.4%	4.4%
Divorced	7.2%	11.5%	9.7%
Separated	3.2%	7.1%	4.4%
Never married	20.1%	48.4%	52.6%
Household income			
Under $20,000	16.2%	30.9%	32.7%
$20,001 to $40,000	18.5%	14.0%	12.4%
$40,001 to $60,000	15.0%	11.2%	15.0%
$60,001 to $80,000	12.3%	3.4%	1.8%
Over $80,000	22.9%	12.9%	15.0%
Don't know	11.5%	22.5%	19.5%
Refused	3.7%	5.1%	3.5%

Source: HWSS

4.4.3. Hospital Morbidity Database System

Of the 114 respondents who reported a suicide-related behaviour and were successfully linked, only ten respondents (8.8%) had a linked hospital admission for intentional self harm (an ICD-10 code of X60 to X84) in the 12 months prior to their HWSS interview, with females accounting for the greatest proportion.

HMDS records for the same respondent where the admission date was the same as another record's separation date were ignored as these would have been hospital transfers. Fewer than five[9] respondents had more than one intentional self harm admission in the year prior to their HWSS interview (these were not transfers). All the respondents with multiple admissions were female.

Each hospital admission had up to four external causes of injury codes, which is where the intentional self harm was recorded. Intentional self poisoning was the most commonly reported cause of injury. (Note: These classifications were not mutually exclusive, so one admission could have up to four external cause classifications.) Further breakdowns of the type of injury code have not been included to ensure confidentiality.
As with the external cause of injury, poisoning was the most reported principal diagnosis. Fewer than five[9] of the admissions spent time in psychiatric care.

An additional less than five[9] male respondents who answered "no" to the question about suicide-related behaviour had a linked hospital admission for intentional self harm in the 12 months prior to their HWSS interview. These respondents also reported no suicide ideation in the last 12 months. Again, fewer than five[9] of these respondents with no reported ideation had two separate admissions. These admissions also had an e-diagnosis of Mental and Behavioural disorders due to use of alcohol (ICD-10 code of F10). As none of the admissions spent time in psychiatric care it is unclear as to whether the HWSS response was incorrect, or whether the hospital admissions were incorrectly coded, particularly with the admissions due to poisoning.

[9] Cases with fewer than five have not been reported to ensure confidentiality, as per DoH guidelines.

4.4.4. Emergency Department

As Emergency Department (ED) information was only available from January 2002 onwards, the analysis of the HWSS data linked with ED information was limited to January 2003 to June 2008 to enable analysis of ED presentations within the 12 months prior to the HWSS interview. There were 20,270 HWSS interviews between January 2003 and June 2008 that were linked to other health data sets. These interviews were from 19,752 individuals.

One in five HWSS responses (4,036 or 19.9%) had an ED presentation for any cause in the year prior to their HWSS interview. Respondents who reported suicide ideation were significantly more likely to have an ED presentation for any cause in the year prior to their HWSS interview compared with respondents who reported no suicide ideation (32.7% compared with 19.3%, x^2 (1) = 90.8, *OR* = 2.0, $p<.001$). Similarly, respondents who reported suicide-related behaviour were significantly more likely to have an ED presentation in the year prior to their HWSS interview compared with respondents who reported no suicide-related behaviour (48.0% compared with 19.7%, x^2 (1) = 49.9, *OR* = 3.7, $p<.001$).

The 4,036 HWSS respondents had 7,371 ED presentations for any cause in the year prior to their interview. There were differences in the diagnostic information available for the ED presentations due to differences in the reporting tools used. The hospitals that use the Emergency Department Information System (EDIS) – metropolitan hospitals and Bunbury Regional Hospital – provided principal diagnosis information in the form of ICD-10 codes as well as presenting problem information in the form of a coded term set. The hospitals that do not use the EDIS (the rural hospitals) only provided diagnostic information in the form of very broad ICD codes or free text. As most of the respondents reporting suicide-related behaviour were from non-metropolitan areas (62.3%), no information regarding the reason for the ED presentation was available for most of the cases. As shown in Table 4.21 there were 1,119 ED presentations (15.2%) that had no

ICD-10 diagnosis or major diagnostic category; 678 had no information and another 441 had only free text.

Table 4.21: Diagnosis information of ED presentations

Diagnosis information	no.	%
No information	678	9.2
Free text only	441	6.0
ICD-10 diagnosis or symptom only	43	0.6
ICD-10 diagnosis and symptom	1,427	19.4
Major diagnosis category only	4,782	64.9

Source: EDDC

There were no presentations with an ICD-10 code of intentional self-harm (X60-84), but only one-quarter of ED presentations (1,428 or 24.0%) had an ICD-10 diagnosis code. The major diagnostic category, which was available for nearly two-thirds of the ED presentations are shown in Table 4.22. Injuries, poisonings & toxic effects of drugs accounted for the greatest number of presentations (801).

However, the major diagnostic category alone did not provide sufficient information to determine whether presentations were related to a suicide-related behaviour. The categories of "Mental diseases and disorders", "Substance use and substance induced organic mental disorders" and "Injuries, poisonings & toxic effects of drugs" may have included presentations related to suicide-related behaviour, but there was no additional information regarding intent. While there was an intent variable on the data, this was "unknown" for 96.3% of presentations. Similarly, the external cause was "unknown" for 96.5% of presentations.

Table 4.22: Major diagnostic category of ED presentations

Major Diagnostic Category	no.	%
Burns	26	0.4
Diseases & disorders of blood & blood forming organs & immunological	57	0.8
Diseases & disorders of musculoskelal system & connective tissue	564	7.7
Diseases & disorders of the circulatory system	393	5.3
Diseases & disorders of the digestive system	482	6.5
Diseases & disorders of the ear, nose & throat	361	4.9
Diseases & disorders of the eye	224	3.0
Diseases & disorders of the female reproductive system	65	0.9
Diseases & disorders of the hepatobiliary system & pancreas	27	0.4
Diseases & disorders of the kidney & urinary tract	170	2.3
Diseases & disorders of the male reproductive system	14	0.2
Diseases & disorders of the nervous system	199	2.7
Diseases & disorders of the respiratory system	376	5.1
Endocrine, nutritional & metabolic diseases & disorders	25	0.3
Factors influencing health status & other contacts with health services	693	9.4
Infectious & parasitic diseases	90	1.2
Injuries, poisonings & toxic effects of drugs	801	10.9
Mental diseases & disorders	77	1.0
Myeloproliferative diseases & disorders, & poorly differentiated	8	0.1
Pregnancy, childbirth & the puerperium	108	1.5
Substance use & substance induced organic mental disorders	22	0.3
Unknown	2,589	35.1

Source: EDDC

To try to select the ED presentations that may have been a suicide-related behaviour, ED presentations with a major diagnostic category of 'mental diseases and disorders', or a symptom of 'depression' or 'suicidal' were identified. During the study period there were 93 ED presentations from 54 respondents with one of these diagnoses. Fourteen of these respondents self-reported suicide-related behaviour in the HWSS. When the diagnoses were extended to also include 'substance use and substance induced organic mental disorders' and 'injuries, poisonings and toxic effects of drugs' there were 916 ED presentations from 759 respondents. Twenty two of these respondents self-reported suicide-related behaviour in the HWSS.

To investigate the ED presentations for intentional self-harm the presentations of the respondents who reported a suicide-related behaviour in the HWSS were selected. The major diagnostic category of these ED presentations is shown in Table 4.23. Nearly half of the ED presentations (48.2%) had an unknown major diagnostic category. Mental diseases and disorders was the most commonly reported diagnostic category (10.2%).

Table 4.23: Major diagnostic category of ED presentations for those with self-reported suicide-related behaviour

Major Diagnostic Category	no.	%
Burns	0	0.0
Diseases & disorders of blood & blood forming organs & immunological	<5	n/a
Diseases & disorders of musculoskelal system & connective tissue	5	3.0
Diseases & disorders of the circulatory system	0	0.0
Diseases & disorders of the digestive system	12	7.2
Diseases & disorders of the ear, nose & throat	6	3.6
Diseases & disorders of the eye	<5	n/a
Diseases & disorders of the female reproductive system	<5	n/a
Diseases & disorders of the hepatobiliary system & pancreas	0	0.0
Diseases & disorders of the kidney & urinary tract	<5	n/a
Diseases & disorders of the male reproductive system	0	0.0
Diseases & disorders of the nervous system	6	3.6
Diseases & disorders of the respiratory system	<5	n/a
Endocrine, nutritional & metabolic diseases & disorders	0	0.0
Factors influencing health status & other contacts with health services	6	3.6
Infectious & parasitic diseases	0	0.0
Injuries, poisonings & toxic effects of drugs	12	7.2
Mental diseases & disorders	17	10.2
Myeloproliferative diseases & disorders, & poorly differentiated	0	0.0
Pregnancy, childbirth & the puerperium	<5	n/a
Substance use & substance induced organic mental disorders	9	5.4
Unknown	80	48.2

n/a not available due to small case size.
Note: cases with no coded symptom, but a free text complaint field were coded.
Source: EDDC

The majority of the presentations with an unknown major diagnostic category had symptom (presenting problem) information, as shown in Table 4.24. Social/behavioural

symptoms were the most commonly reported, accounting for 31.3% of these presentations, followed by pain (17.5%) and injury (16.3%). There were seven presentations with a symptom of "suicidal" and fewer than five with a symptom of "deliberate self-harm". As only cases with no major diagnostic category had a symptom, it was not possible to determine what major diagnostic category was used for suicide-related behaviour. The presentations with a symptom of 'suicidal' or 'deliberate self-harm' had ICD-10 codes other than intentional self-harm.

Table 4.25 shows the major diagnostic category or symptom of the 23 ED presentations that subsequently appeared as an intentional self-harm admission in the HMDS (these included admissions not included in this study as they fell outside the one year reference period of the HWSS). Mental diseases and disorders and drug/alcohol use were the most commonly cited diagnoses.

Only 12 of the 13 respondents with an HMDS admission for intentional self-harm had an ED presentation on either the same date or the day before their admission. There was no information available regarding the referral source of these admissions as this was unfortunately not part of the requested data. None of the ED presentations with a symptom of 'suicidal' subsequently appeared as intentional self-harm HMDS admissions. Furthermore, none of the ED presentations with a symptom of 'suicidal' had a MHIS contact date around the same time.

Table 4.24: Symptom of ED presentations with unknown major diagnostic category for those with self-reported suicide-related behaviour

Symptom	no.	%
Blood/Immune	0	0.0
Cardiac Vascular	<5	n/a
Diabetes/Endocrine	0	0.0
Drug/Alcohol Use	7	8.8
Ent/Oral	0	0.0
Eye	0	0.0
Gastrointestinal	<5	n/a
Injury	13	16.3
Neurological	<5	n/a
Non emergent/Reviews	0	0.0
Obstetrics/Gynaecological	<5	n/a
Pain	14	17.5
Poison/Chemical exposure	<5	n/a
Provisional Diagnosis	<5	n/a
Regional Problems	<5	n/a
Respiratory	<5	n/a
Social/Behavioural	25	31.3
Anxiety/Panic	<5	n/a
Deliberate Self Harm	<5	n/a
Depressed	<5	n/a
Hallucinations	0	0.0
Inappropriate Behaviour	<5	n/a
Psychiatric problem	<5	n/a
Requesting Psychiatric Review	<5	n/a
Situational crisis	<5	n/a
Social/Behavioural	<5	n/a
Suicidal	7	8.8
Violent/Aggressive Behaviour	0	0.0
Temperature/Environmental	0	0.0
Urology/Reproductive	0	0.0
Unknown	<5	n/a

n/a not available due to small case size.
Source: EDDC

Table 4.25: Major diagnostic categories and symptom of ED presentations regarded as HMDS intentional self-harm admissions

	no.	%
Major Diagnostic Category		
Mental diseases and disorders	5	21.7
Substance use and substance induced organic mental disorders	<5	n/a
Injuries, poisonings and toxic effects of drugs	<5	n/a
Symptom		
Drug/Alcohol Use	5	21.7
Injury	<5	n/a
Neurological	<5	n/a
Poison/Chemical exposure	<5	n/a
Respiratory	<5	n/a
Deliberate Self Harm	<5	n/a
Social/Behavioural	<5	n/a

Source: EDDC

4.4.5. Deaths

There were 515 deaths, with nine of these deceased having completed two HWSS interviews. The nine respondents who completed two HWSS interviews reported no suicide ideation or suicide-related behaviour on either interview. As the death information was prospective to the HWSS information only the most recent HWSS interview was retained.

Fewer than five[10] respondents who died had reported a suicide-related behaviour in their HWSS interview, as shown in Table 4.26. Only one respondent who appeared in the hospital admission information with an intentional self-harm record subsequently died and this death was not a possible suicide.

[10] Cases with fewer than five have not been reported to ensure confidentiality, as per DoH guidelines.

Table 4.26: Death by reported suicide ideation and suicide-related behaviour

	Died	
	Yes	No
Suicide ideation[a]		
Yes	19	926
No	494	20,558
Don't know/Can't remember	<5	19
Refused	<5	18
Suicide-related behaviour		
Yes	<5	105
No	511	21,365
Don't know/Can't remember	0	5

[a] 13 respondents reported suicide ideation, but no information regarding suicide-related behaviour
Note: Respondents who completed the HWSS more than once only appear once in the table above.

A similar proportion of respondents who reported suicide ideation subsequently died compared with those who reported no suicide ideation in their HWSS interview (2.0% compared with 2.3%). Similarly, around 2% of respondents subsequently died regardless of their suicide-related behaviour (2.3% for those reporting no compared with 1.9% for those reporting yes).

A binary logistic regression was conducted to assess whether suicide ideation and/or suicide-related behaviour was associated with death by any means. As shown in Table 4.27, being female was a protective factor, as was being aged less than 65 years. Reporting suicide ideation or a suicide-related behaviour in the HWSS was not significantly associated with a subsequent death. When suicide-related behaviour was removed from the model the *p*-value of suicide ideation reduced, but it remained just outside significance (p=.068).

Table 4.27: Logistic regression coefficients of death

	OR	95% CI
Female	0.5 ^	(0.4 - 0.6)
Age (ref = 65+)		
16-24 yrs	0.0 ^	(0.0 - 0.0)
25-44 yrs	0.0 ^	(0.0 - 0.1)
45-64 yrs	0.2 ^	(0.1 - 0.2)
Suicide ideation (ref = yes)	0.7	(0.4 - 1.1)
Suicide attempt (ref = yes)	0.6	(0.1 - 2.9)

Age as at the HWSS interview

Survival curves were graphed to determine if there was a significant difference in the survival time of respondents who reported suicide ideation or suicide-related behaviour. There was no significant difference in the survival time of respondents who reported suicide ideation compared with those who didn't (the log-rank x^2 (1) = 1.0, p = .318). Similarly, there was no significant difference in the survival time of respondents who reported suicide-related behaviour compared with those who reported no such behaviour (the log-rank x^2 (1) = 0.2, p = .666).

The variables were entered into a Cox proportional hazards regression. In the single-predictor analysis neither suicide ideation nor suicide-related behaviour were significantly associated with survival time (p=.320 and p=.668 respectively). These variables remained not significant when entered into a Cox proportional hazards regression with multiple-predictors such as age, sex, BMI category and general health status.

Only the death data with a registration year of 2006 or earlier had a coded cause of death. This equated to only 199 or 38.6% of deaths. There were fewer than five[11] deaths with an intentional self harm (ICD-10 code of X60-84) cause of death. In each of these cases the respondents had responded "no" to the suicide attempt question when they

[11] Cases with fewer than five have not been reported to ensure confidentiality, as per DoH guidelines.

answered the HWSS. Only one respondent had answered "yes" to the suicide ideation question.

The cause of death text was used to categorise all deaths. Deaths that were classified by a coroner as deliberately self inflicted were regarded as a suicide. Using this classification there were seven deaths that would be regarded as a suicide. There were 15 deaths that were awaiting a coronial inquiry, while less than five deaths were classified as a suicide using the cause of death code, but not using the cause of death text, which made reference to 'accidental'. An additional six deaths were regarded by a coronial inquiry as accidental – most of these involved a motor vehicle accident. These six deaths were not regarded as potential suicides in this study.

The average time between the HWSS interview and suicide was 30.4 months and 32.7 months between the HWSS interview and a death awaiting coronial inquiry.

4.4.6. Mental health information

The mental health information from the HWSS was merged with the MHIS information that related to a clinical contact from the year prior to the interview. Almost all respondents (99.6%) who reported no mental health service usage in the last 12 months had no MHIS records in the year prior to their HWSS interview. However, there were no MHIS records for the vast majority (829 or 80.8%) of the respondents who reported that they had used mental health services in the last year.

When the MHIS records were expanded to include all contact types and not just clinical contacts, there were 11 respondents who had a non-clinical MHIS record in the year prior to the HWSS interview, which included the following contact types: liaison, administration, National Outcome and Casemix Collection (NOCC) and undefined.

While the MHIS reporting has increased with time, the proportion of HWSS respondents appearing in the MHIS remained fairly stable across the years (see Table 4.28). Of the

respondents who reported mental health service use in the HWSS and had linked MHIS data, only 7.5% had the same number of mental health contacts in the MHIS as self-reported in the HWSS. Nearly two thirds (63.6% or 196) had more contacts in the MHIS than were self-reported in the HWSS. This is not surprising given that private mental health services, such as private psychologists would not enter their data into the MHIS.

Table 4.28: Self-reported mental health usage (HWSS) compared with MHIS by year

HWSS		MHIS			
		no		%	
		Yes	No	Yes	No
2002	Yes	22	66	25.0%	75.0%
	No	8	2045	0.4%	99.6%
2003	Yes	20	84	19.2%	80.8%
	No	8	1975	0.4%	99.6%
2004	Yes	23	103	18.3%	81.7%
	No	8	2593	0.3%	99.7%
2005	Yes	44	190	18.8%	81.2%
	No	22	4677	0.5%	99.5%
2006	Yes	12	42	22.2%	77.8%
	No	<5	1024	n/a	99.6%
2007	Yes	50	217	18.7%	81.3%
	No	22	4854	0.5%	99.5%
2008	Yes	26	127	17.0%	83.0%
	No	9	2677	0.3%	99.7%

n/a not available due to small case size.
Source: HWSS and MHIS

Of the 114 responses with a suicide-related behaviour in the HWSS, only 29 (25.4%) had a clinical contact MHIS record in the year prior to their interview. There were five respondents with collectively ten hospital admissions for a suicide-related behaviour in the year prior to the HWSS interview who also had linked MHIS records. Seven of these ten admissions had a mental health record within one month of the attempt. Again, it cannot be inferred that the remaining cases had no contact with any mental health professionals as they may have visited private professionals who do not provide their information to the MHIS.

CHAPTER FIVE

DISCUSSION

5.1. HWSS

The HWSS is a population telephone survey that collects information across a wide range of health related topics including chronic health conditions, lifestyle factors, socio-economic and demographic variables. The breadth of information collected enables the HWSS to be used for numerous research topics, whether for ongoing surveillance or in combination with other data sets.

The survey collects information from around 6,500 respondents each year, providing a large sample size and permitting the assessment of uncommon events, such as suicide-related behaviour. Due to the nature of the sample design, the sample size and the standard questions used, it is possible to use the HWSS for surveillance at a state, a sub-state and a national level when pooled with other similar collections. Hence, the HWSS provides a wealth of opportunities for research, without the extensive time and money investment usually required to collect such information.

In addition, as the HWSS began in 2002 and is collected on almost every day of the year, it enables the assessment of both changes over time and seasonality. This ability is advantageous not only for studies such as this one, that wish to analyse changes in conditions, or risk factors in their own right, but also enables the assessment of legislative changes and campaigns. For example, the HWSS was used to determine the impact of daylight saving on physical activity (Daly et al. 2007) and to assess a campaign to eat fruit and vegetables (Pollard et al. 2008).

5.1.1. Sample Frame

The use of computer assisted telephone interviews has the potential to bias the results of the HWSS due to the representativeness of the sampling frame. The HWSS uses the Electronic White Pages (EWP) as its sampling frame, so households that do not have a telephone connection, or have an unlisted (silent) telephone number would not be included on the frame and so would be out of scope of the HWSS. Hence the HWSS may not be representative of some groups, such as homeless people and ATSI people who live in communities without telephones, or those with a communal telephone. As suicidal behaviour is reported to be higher in these groups (Merete 2011; Prior 2011), the results from this study are likely to understate the true prevalence of suicidal behaviour.

In 2007, 89.3% of Western Australian households had a landline and 90% had one or more mobile telephone (Australian Bureau of Statistics 2008c). Households in the Perth metropolitan region were more likely than the remainder of the state to have a telephone, with 90.2% of households in the Perth metropolitan region having a landline compared with 86.6% of households in the non-metropolitan region (Australian Bureau of Statistics 2008c). This difference would have affected the likelihood of participating in the HWSS. Furthermore, households comprising of a couple with or without children were more likely to have a landline than other household structures (95.4% compared with 81.9%), as were households with at least one person aged 60 years and over (Australian Bureau of Statistics 2008c). The use of listed telephone numbers as a sampling frame is likely to increase in bias over time with the increase in mobile phone and internet technology, such as naked DSL where one is no longer required to have a landline for the internet. This technology is often adopted by young adults, making a difficult to reach cohort even more challenging. As naked DSL was only introduced to Australia in late 2007, and provided even later by Optus and Telstra - the large communication providers - this may not have had a large impact on this study as the responses were collected between 2002 and 2008.

However, at the time when the 2008 HWSS responses were collected the last publicly available version of the EWP was from 2004 and so the sampling frame was several years out of date. During this period Western Australia underwent a resources boom, resulting in Western Australia recording the second highest population growth in the nation between June 2003 and June 2008 (13%) (Australian Bureau of Statistics 2012h, 2012b, 2012g, 2012d, 2012e, 2012f, 2012c, 2012a). This increase resulted in an additional 199,000 people aged 16 years and over residing in the State between June 2003 and June 2008 (Australian Bureau of Statistics 2012h).

If the increase in population were re-assigned previously existing telephone numbers then one could argue that the sampling frame remained representative of the population even though it was out of date. However, there were an additional 173 suburbs created in Western Australia between 2004 and 2009 (Landgate Geographic Names Committee 2010). At least some of these suburbs would have been assigned new telephone exchanges and therefore newly created telephone numbers. In addition, silent numbers are not included in the EWP. The proportion of private telephone numbers that are silent numbers is not readily available, but in 1992 it was estimated that 15% of telephone numbers in WA were silent (Donovan et al. 1997). Given the increasing trend in recent years for cold calling by telemarketing and market research, and the resulting Do Not Call Register introduced in 2006 (ComLaw nd), this proportion may have increased. Such an increase was found in South Australia, where unlisted numbers increased from 17.3% to 20.2% between 1994 and 2002 (Dal Grande, Taylor & Wilson 2005). In the South Australian study people with an unlisted number were more likely to be living in younger age groups, in the metropolitan region and in single adult households. As a result telephone surveys based on the EWP may not be representative of young people and may underreport issues such as mental health and suicide ideation (Dal Grande, Taylor & Wilson 2005). While mobile telephone numbers were in scope of the HWSS, this was only the case if they were provided as an alternate number once contact was made or if they were listed in the EWP and many people do not list their mobile numbers.

The mobility of the population may also have affected the representativeness of the sampling frame. In the 2006 Census 80.4% of Western Australians aged 15 years and over reported the same usual place of residence as one year ago, with younger people less likely to report the same residence (70.9% of 15 to 24 year olds and 67.0% of 25 to 34 years) compared with older adults (91.8% of 65 year olds and over) (Australian Bureau of Statistics 2007a). However, while this may have reduced the number of people who received the introductory letter prior to being contacted for the HWSS interview, if these people kept their same landline, or were issued a previously existing one, these people would still have been eligible to be selected for the HWSS. While introductory letters were sent, the telephone number called was ultimately the method that selected respondents.

These potential biases with the sampling frame are particularly important for an area such as suicidal behaviour, as suicide ideation and suicide-related behaviour is more prevalent in the younger populations (Kessler, Borges & Walters 1999; Renberg 2001; De Leo et al. 2005; Gibb, Beautrais & Fergusson 2005; Beautrais et al. 2006; Borges et al. 2007; Levinson et al. 2007; Kuo, Gallo & Tien 2001; Crosby, Cheltenham & Sacks 1999) who are likely to be more mobile and less likely to have a landline. Hence the HWSS and therefore the results of this study are likely to have some form of bias as a result of this sampling frame.

5.1.2. Response rates

The HWSS has obtained very high response rates, increasing from 58.1% of the eligible sample in 2002 to 76.7% in 2008. When unanswered telephones were removed from the denominator these response rates increased to 68.2% in 2002 and 83.3% in 2008. Furthermore, if the response rates were derived by dividing the completed interviews by the interviews plus refusals, these response rates increased to 68.5% in 2002 and 89.5% in 2008. No information was available for the households that did not answer or refused to be interviewed, so it was not possible to conduct an assessment of non-response bias.

Up to eight calls were made to each household at different times of the day, which would have minimised any potential selection bias of households not answering. Over the study period there were some minor changes to how the person interviewed was selected. Initially the person in the household with the next birthday was selected, but the method was altered to a quota system around 2007, where people in younger age groups were actively asked for in 68 of every 100 calls so as to obtain sufficient numbers of younger people, who are harder to contact (Department of Health Western Australia 2005a; S. Joyce, personal communication 2011).

5.1.3. Demographics

As is commonly found in surveys, females were over-represented in the responses to the HWSS, comprising 58.8% of the sample, but only 49.7% of the 2008 ERP (Australian Bureau of Statistics 2012h). Similarly, older respondents (65 years and over) were over-represented, comprising 22.4% of the sample, but only 15.2% of the 2008 ERP (Australian Bureau of Statistics 2012h). These differences were however, accounted for in the analysis of the prevalence estimates as the data were weighted to the ERP.

In addition to the potential sampling bias related to age that was discussed earlier, there may also be demographic or socio-economic factors associated with whether or not people participate in a survey. While age and gender have been accounted for by the weighting, any other biasing factors have not.

5.1.4. Questions on HWSS

The HWSS was designed to monitor the health and wellbeing of the general population, rather than to be a specific questionnaire asking about suicidal behaviour. The question asking about suicide-related behaviour asked “In the past 12 months have you tried to end your own life?” While it seems that this question implies intent, it is not explicitly asked. Nock and Kessler (2006) found that even when asked a question with implied intent - “have you ever attempted suicide” - 42% of those answering yes also indicated

that their attempt was a cry for help and they had no intention to die. Hence, in this study it was not possible to determine intent and to therefore distinguish suicide-gestures from suicide-attempts. Similarly, it was not possible to determine intent in any of the hospital information.

One of the major associates of suicidal behaviour is a mental health problem (Beautrais 2000, 2001; Kuo, Gallo & Tien 2001; Beautrais 2003). For around half of the study period (from 2005 to 2008), the question asking whether respondents were currently receiving treatment for a mental health problem was only asked of respondents who reported having been diagnosed with a mental health problem in the last 12 months. As a result, no information was available from the HWSS regarding treatment for mental health problems diagnosed prior to the year before interview. This would have excluded anyone with an ongoing mental health condition that was diagnosed more than a year ago. Even so, in this study having been diagnosed with depression, anxiety, stress or another mental health problem in the last year (referred to as a current mental health problem) was still found to be a significant risk factor for suicide ideation and suicide-related behaviour.

In addition, many of the mental health questions, including those from the Kessler 10 which include feelings of hopelessness, depression and worthlessness; those from the SF8 which include feelings of bodily pain; and those regarding perceived lack of control refer to the last 4 weeks rather than to the last 12 months. Hence the different and shorter reference time period for these questions may have limited their association with the suicide ideation and suicide-related behaviour, particularly if these are transient feelings. Due to the dynamic nature of the HWSS, there were questions that changed or were added during the study period and were therefore only available for a limited cohort of the study population. This was the case for the question asking whether any family member had tried to end their own life in the last 12 months, which was introduced to the HWSS in 2006.

The HWSS collected information on whether respondents had ever been diagnosed with cancer. However, this question was asked in reference to having ever been diagnosed and collected no information as to when the respondent had cancer. As a result there is no way to link suicide-related behaviour with the cancer prognosis, as found in some studies (Spoletini et al. 2011). While cancer was a significant associate of suicide ideation and suicide-related behaviour in the single-predictor analysis it was not included in the final model.

The life stressor information, such as how many times in the last year someone experienced the death of someone close, were asked in relation to whether they happened either directly to the respondent or had an effect on the respondent. So while life stressors have been found to be related to suicide ideation (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998) it is not possible in this study to determine whether the event happened directly to the respondent.

There was little information regarding social support and social capital collected by the HWSS. As these have been shown to be associated with suicide ideation and suicide-related behaviour (Vilhjalmsson, Sveinbjarnardottir & Kristjansdottir 1998) this may be a limitation of this study. Furthermore, there was no information regarding what, if any, events may have occurred prior to the suicide ideation and/or suicide-related behaviour. If this behaviour was impulsive as a result of a particular event (Bender et al. 2011) then this information would not be available within this study.

Therefore, while the HWSS provides a wealth of information and enables studies such as this one to be performed without the need to collect information, it is not without its limitations. If information from the HWSS were to have been designed and collected for a study addressing suicide ideation and suicide-related behaviour the questions would have been individually selected and designed and hence the issues experienced with the different reference periods and questions not having been asked of everyone would not have occurred. However, this would have been at a considerable expense both in terms of human and financial resources.

5.2. Data Linkage

WA is in the fortunate position to be one of only a handful of places worldwide with the 'linkage of multiple large, population-based, administrative data sets' (Roos et al. 2004 cited in Holman et al. 2008 p. 767), with its linkage commencing in 1995 and fully operational since 1998 (Holman et al. 2008). The core data sets included in the linkage (both health and non-health) are covered by legislation, which ensures the data is provided (Holman et al. 1999). This data linkage enables a multitude of research opportunities without the need to collect data, which not only saves time and money, but allows studies, including retrospective designs, that would otherwise not be possible.

Using data linkage this study was able to combine the self-reported survey responses from the HWSS with administrative health data, while maintaining the confidentiality of all the study subjects. This linkage was possible because respondents to the HWSS were asked for their agreement to link their data when completing their phone survey, even though there was no specific research study in mind at the time. In addition to the wealth of information the linkage provided, it also allowed an objective assessment of the self-reported information.

Three-quarters of respondents to the HWSS (77.0%) agreed for their information to be linked to other health data sets, with 96.1% of these successfully linked (74.0% of the total sample). This agreement for data to be linked is slightly lower than achieved by the Health Survey for England (HSE) (Gray 2010) and the Taiwan National Health Interview Survey (Huang et al. 2007), but nearly double that of the British Household Panel Survey (Sala, Burton & Knies 2010). Unlike in the HWSS, in the HSE respondents were asked for linkage to specific data sets, which Gray (2010) suggests may increase respondents' likelihood to agree to linkage.

Considering that 23% (7,059) of respondents to the HWSS did not agree for their information to be linked, this represents the potential for a strong self selection bias, which would need to be taken into account in future data linkage studies. This linkage

may reflect a selection bias in regards to the characteristics of respondents who either agreed for their health information to be linked and/or were able to be successfully linked.

When analysed using logistic regression, agreeing for their HWSS information to be linked to other health data sets was significantly associated with being male; being older (65 years+); living in a rural, but not remote area[12]; having a higher household income ($80,000); having a TAFE/trade qualification or having completed year 10 (compared with a tertiary or year 12 education); living with parents, or a with a partner and children (compared with living alone). There was also a significant age by sex interaction, with males aged 45 years and over significantly more likely to agree to the linkage compared with females of the same age. This gender finding was surprising, in light of the propensity for females to be more likely than males to respond to telephone surveys.

The finding that older people were more likely to agree to the linkage is supported by previous studies in the USA (Woolf 2000) and Australia, though there are contradictory findings from other countries (Huang et al. 2007). Similarly, as in this study some studies have also found that males are more likely to consent to the linkage than females (Woolf 2000).

Sala, Burton and Knies (2010) found that attitudes towards privacy and community-mindedness have more impact on consent than demographic characteristics (Sala, Burton & Knies 2010). This notion is supported by studies that have found that people who refuse to provide information on income or wealth, a topic generally viewed as private, are less likely to agree to their data being linked (Jenkins et al. 2006). Furthermore, this issue was supported by this study's findings that people who refused to provide household income or suicide ideation information were less likely to consent to the linkage.

[12] The rural/remote classification was based on the HWSS sample design, where remote was defined as the Kimberley and Pilbara only. The Goldfields, which consists of several remote areas was classified as rural rather than remote.

Having the data successfully linked was associated with: being male; being older (65 years+); living in a rural area; being married or in a de facto relationship and living with parents. Living with other friends was significantly associated with a lower likelihood of a successful linkage. There was also a significant age by sex interaction. Females in the 16 to 24 years and 25 to 44 year age groups were significantly more likely to be successfully linked compared with males of the same age. This finding may be a reflection of this age group of females being in their child bearing years and likely to have records related to this experience. Of particular note is that without the sex by age interaction included in the model females rather than males had an increased likelihood of being successfully linked. An increase in age was associated with a greater likelihood both to agree for data to be linked and for the information to be successfully linked.

Interestingly having been interviewed in any year other than 2008 (2002 to 2007) significantly increased the odds of a respondent being successfully linked. As the address was provided along with name and date of birth for the linkage the increased likelihood of addresses to be outdated by 2008 may have adversely affected the ability to link these records.

Reporting suicide ideation in the last year was not significantly associated with agreeing to the linkage. While suicide-related behaviour was not included in the logistic regression because of its dependency on suicide ideation, respondents who reported yes or don't know to the suicide-related behaviour were less likely to agree to the linkage compared with those who reported no (67.0% compared with 77.2%). Hence, there may have been an inherent bias in those agreeing to have their data linked that would have affected this study.

5.3. Data Quality Issues

The HWSS was designed as a continuous population health survey to monitor the health and wellbeing of the general population, so while it is very useful for research projects like this one, there are limitations with using the information for specific projects, as

previously discussed. The questions on the HWSS are viewed as reliable and valid questions as they were selected by experts both within WA and other state Health Department jurisdictions (Department of Health Western Australia 2005a) and continue to be used in several national health surveys.

There is little, if any, information available regarding the reliability of self-reported information, however this information tends to remain stable over time (Wood & Daly 2007b; Tomlin, Joyce & Patterson 2012), suggesting that respondents do generally provide reliable answers. The recent Australian Health Survey (AHS) collected biomedical measurements including height and weight from 18 year olds and over. These physical measurements resulted in fairly similar proportions as self-reported in the 2011 HWSS (34.1% not overweight or obese in the AHS compared with 33.7% in the HWSS; 36.5% overweight in the AHS compared with 40.2% in the HWSS; and 29.4% obese in the AHS compared with 26.1% in the HWSS) (Tomlin, Joyce & Patterson 2012; Australian Bureau of Statistics 2012i). The similarity of these results suggests that self-reported information is generally fairly reliable, albeit with an underestimation of weight.

While the other data sets used were from administrative data and so do not suffer from the same potential reliability issues of self-reported survey data, when using multiple data sets there is always the potential for contradictory information. For example, ATSI indicators may differ both between and within data sets (Draper 2009) as a result of assumptions made by the person collecting the information, errors in recording and differences in propensity to identify based on the situation. So it was expected that there may be some level of inconsistency between hospital records. However, there were data quality issues inherent within the individual data sets used that created limitations for this study. Most notably was the inability to identify suicide-related behaviour from the EDDC. As one would not expect all ED presentations involving suicide-related behaviour to be subsequently admitted to hospital (and therefore to be identifiable in the HMDS), the inability to identify these cases was a major limitation within this study. In addition, the different coding used within metropolitan and Bunbury hospitals and the

rest of the State resulted in an inconsistent data set, further limiting the usefulness of the ED data. This inconsistent coding may be alleviated when all ED within WA hospitals move to the same reporting system (WebPAS).

5.4. Study objectives

This study had six objectives, which will be discussed individually below.

Objective One:

To estimate the prevalence of suicide ideation and suicide-related behaviour among Western Australian adults

Suicide ideation

The prevalence of suicide ideation in the previous year for Western Australians aged 16 years and over ranged from 3.3% in 2007 to 5.3% in 2006. These prevalence estimates were similar to the estimates by other health surveys across the world (Beautrais et al. 2006; Borges et al. 2006; Crosby, Cheltenham & Sacks 1999, Goldney et al. 2000; Gunnell et al. 2004; Hintikka et al. 1998; Kessler et al. 2005; Pirkis, Burgess & Dunt 2000; Ramberg & Wasserman 2000; Renberg 2001; Taylor et al. 2007; Fairweather et al. 2006).

There was no significant gender difference, with the prevalence of males ranging from 2.8% in 2007 to 4.8% in 2003, while the prevalence of females ranged from 3.4% in 2008 to 6.2% in 2006. When considered in a single-predictor logistic regression females were significantly more likely to report suicide ideation, however the reverse was true when other variables were included. This latter finding is in contrast to that of Beautrais et al. (2006) who found suicide ideation was significantly higher among females than males and may suggest that the higher prevalence of suicide ideation often found among females is influenced by other confounding variables.

When the analysis was limited to only 16 to 24 year olds, which enabled a longer time series, the annual prevalence estimates of suicide ideation increased to a range of 5.1% in 2007 to 10.7% in 2006. These estimates were considerably lower than the 26% found by Meehan et al.'s (1992) study of 18 to 24 year olds. This difference may be related to the different time periods (the HWSS was collected more than a decade later) and also differences in the sample, Meehan et al.'s study included only university students. Among the 16 to 24 year olds, females reported a significantly higher prevalence than males in three of the seven years.

Suicide-related-behaviour

The prevalence of suicide-related behaviour in the last year for Western Australians aged 16 years and over ranged from 0.3% in 2007 to 0.8% in 2003. This is similar to the prevalence estimates found by other surveys around the world, which ranged from 0.4% to around 1% (Beautrais et al. 2006; Borges et al. 2006; Crosby, Cheltenham & Sacks 1999; De Leo et al. 2005; Fairweather et al. 2006; Hintikka et al. 1998; Kessler et al. 2005; Pirkis, Burgess & Dunt 2000; Ramberg & Wasserman 2000; Renberg 2001). There was a significant gender difference found in only one year (2008), where females reported a significantly higher prevalence than males (0.9% compared with 0.2%). This is in contrast to other studies that found females tended to report suicide-related behaviour significantly more than males (Beautrais 2001). One of the possible reasons that this trend was not observed in this study is because of the small number of respondents who reported the suicide-related behaviour (165 respondents). While the sample size in this study was several times larger than most surveys collecting self-reported suicide-related behaviour, there still may not have been enough power to detect differences in characteristics such as gender.

When the analysis was limited to only 16 to 24 year olds the annual prevalence estimates of suicide-related behaviour increased to a range of 0.6% in 2005 to 2.0% in 2003. These estimates were similar to the 1.9% found by Meehan's (1992) study of 18 to 24 year olds. Despite females consistently reporting higher prevalence estimates than

males, the gender difference was only significant in one year (2004), with 3.1% of females compared with 0.1% of males. However, the significance would have been affected by the small number of respondents reporting suicide-related behaviour.

Objective Two:

To determine whether there was a change in the suicide ideation and suicide-related behaviour of the Western Australian adult population between 2002 and 2008

Time series analysis was used to determine if there were any significant changes in the prevalence of either suicide ideation or suicide-related behaviour over the study period. There was no significant trend found over time in the suicide ideation of 16 to 24 year olds or 16 years and over age group. This finding remained when males and females were analysed separately.

Similarly, there was no significant trend found over time in the suicide-related behaviour of 16 to 24 year olds or 16 years and over. This finding was in contrast to the WA age adjusted hospitalisation rate of intentional self harm during the same period, which showed a significant increase (Department of Health Epidemiology Branch 2013). As there were only 165 respondents who reported suicide-related behaviour in the study period, the analysis of suicide-related behaviour was not analysed separately for males and females and is likely to have been affected by the small number of respondents reporting such behaviour.

Objective Three:

To explore the associates of both suicide ideation and suicide-related behaviour among Western Australian adults

Many studies investigating risk factors for suicide-related behaviour have compared suicide attempters to respondents with no suicidal behaviour, thus making it difficult to determine whether the associates found are related to suicide-related behaviour itself or suicidal behaviour in general, including ideation. Hence, three separate logistic regression models were created to determine the associates of 1) suicide ideation, 2) suicide-related behaviour of all respondents and 3) suicide-related behaviour of only respondents who reported suicide ideation. The associates of the latter two logistic regressions are discussed together.

Associates of suicide ideation

In the final model for suicide ideation being a young adult increased the odds of suicide ideation, with 16 to 24 year olds nearly twice as likely to report ideation as 25 year olds and older. This finding supports the literature of suicide ideation being more likely among younger respondents (Kessler, Borges & Walters 1999; Renberg 2001; De Leo et al. 2005; Gibb, Beautrais & Fergusson 2005; Beautrais et al. 2006; Borges et al. 2007; Levinson et al. 2007; Kuo, Gallo & Tien 2001; Crosby, Cheltenham & Sacks 1999). In contrast to several previous studies, being male rather than female increased the odds of suicide ideation.

Interestingly being of Aboriginal and/or Torres Strait Islander was not significantly associated with suicide ideation in the multiple-predictor analysis. This may be because ATSI status is a confounding variable, or perhaps a more likely explanation is due to the sampling methodology. While the HWSS collected responses from a similar proportion of ATSI people as in the State, the telephone methodology means remote Aboriginal communities, which are often the subject of reports regarding problems with suicide

(Prior 2011), were likely to be excluded. As a result the responses from the HWSS may not be representative of the entire WA ATSI population.

Living with family members other than parents, or living with a partner was a protective factor, supporting Renberg's (2001) finding that living alone is associated with suicide ideation. These types of living arrangements may provide social support and reduce social isolation, which are known risk factors for suicidal behaviour. While some studies have found marital status to be associated with suicide ideation (Crosby, Cheltenham & Sacks 1999; Taylor et al. 2007; Pirkis, Burgess & Dunt 2000), this variable did not remain significant in the multiple-predictor analysis.

Despite Gunnell (2004) finding that low socio-economic status was associated with increased suicide ideation, SEIFA group did not remain significant in the multiple-predictor analysis. Similarly, although higher education is found to be associated with a lower prevalence of mental health disorders (Andrews, Henderson & Hall 2001), this failed to remain significant. The differences in these findings may be a result of confounding variables.

Unlike several previous studies (Han et al. 2009; Hintikka et al. 2009; Kessler et al. 2009) which found smoking was positively associated with suicidal ideation, this variable failed to remain significant in the multiple-predictor analysis. Furthermore, only two chronic condition risk factors remained in the final model. These were having a disability that places a burden on family; and having been diagnosed with depression, anxiety, stress or other mental health problem in the last year (a current mental health problem), which doubled the likelihood of reporting suicide ideation. Despite being significant in the single-predictor analyses all the other physical health variables failed to remain significant. While alcohol use is found to be associated with suicidal ideation (Han et al. 2009) it also failed to remain significant in the multiple-predictor analysis in this study. Differences in what was being measured may account for some of this difference.

The majority of mental health risk factors remained in the final model, with feelings of lack of control over one's life in general, and over health in the past four weeks; feelings of hopelessness, depression and worthlessness in the past four weeks; use of mental health services; and the number of different types of life stressors all significant risk factors. These findings support those of Vilhjalmsson, Sveinbjarnardottir, and Kristjansdottir (1998) who also found hopelessness and life stressors were associated with suicide ideation.

Having felt depressed in the last four weeks was the strongest risk factor with respondents who reported "Most" or "All of the time" more than four times as likely to report ideation as those who reported no depression. Again, this finding supports the literature, where a mental health problem increases the risk of suicide ideation (Levinson et al. 2007; Borges et al. ; Beautrais et al. 2006; Gunnell et al. 2004), even though the reference period of the last four weeks was very different from that of the suicide ideation question.

Having a friend who attempted suicide in the last year was a significant risk factor of suicide ideation, supporting De Leo et al.'s (2005; 2008) findings, but interestingly having a family member who attempted suicide failed to remain significant in the final model. This finding provides some support for the contagious notion of suicidal behaviour, but does not support the genetic link found in previous studies, such as Statham (1998). However, this may be because the genetic link is related to suicide-related behaviour, and not necessarily to the more prevalent suicide ideation. Furthermore, the question regarding a family member who attempted suicide was only included in the HWSS from 2006 onwards, thus limiting the size of the sample.

The variables that were included in the final model were also assessed with an additional six months of data to determine if they remained significant after the model building process. The only variables that remained significant in the validation model were being aged 16 to 24 years; having been diagnosed with depression, anxiety, stress or other mental health problem in the last year; feeling depressed, worthless in the last four weeks; and mental health service use. All the other variables that were significant in the

model building process (gender; living arrangements; disability; lack of control over one's life in general, health in the last four weeks; feeling hopeless in the last four weeks; number of different types of stressors, having a friend who had attempted suicide in the last year) failed to remain significant. While the much smaller sample size may have affected these results, this finding again points to the possible influence of other uncaptured variables. The inability to replicate the findings of the development model is a limitation of this study and highlights the complex nature of suicidology and the difficulties in suicidology research.

Associates of suicide-related behaviour

In the final models addressing suicide-related behaviour being a young adult increased the odds of suicide-related behaviour, supporting the literature of such behaviour being more likely among younger respondents (Kessler, Borges & Walters 1999; De Leo et al. 2005; Gibb, Beautrais & Fergusson 2005; Beautrais et al. 2006; Borges et al. 2007; Levinson et al. 2007; Kuo, Gallo & Tien 2001). The odds ratio was much greater for 16 to 24 year olds in the model including all respondents than the model including only those reporting suicide ideation, suggesting that ideation alone may account for part of this finding.

Being female was significantly associated with suicide-related behaviour when all respondents were included (females were more than three times as likely as males to report such behaviour), but failed to remain significant when the sample was limited to only those reporting suicide ideation. This differentiation may help to explain why this gender difference was reported by some (Meehan et al. 1992), but not all (Beautrais 2001; Beautrais et al. 2006) studies assessing the prevalence of suicide-related behaviour in the past year.

Again being an ATSI person was not significantly associated with suicide-related behaviour, which is in contrast to findings regarding suicides and suicide-related hospitalisations. At an Australian level the male suicide rate was almost three times

higher among ATSI people than non-ATSI people during 2001 to 2005 (Australian Bureau of Statistics 2008d) and around two times higher for persons between 2001 and 2010 (Australian Bureau of Statistics 2012l). Similarly, in Western Australia the suicide rate of ATSI people was more than double the non ATSI rate between 2001 and 2010 (Department of Health Epidemiology Branch & Cooperative Research Centre for Spatial Information (CRC-SI) 2012a), as was the hospitalisation rate for intentional self harm (Department of Health Epidemiology Branch & Cooperative Research Centre for Spatial Information (CRC-SI) 2012b). The lack of significance found in this study may be a result of the HWSS not being truly representative of the ATSI population.

While low socio-economic status is associated with increased suicide attempts (Kuo, Gallo & Tien 2001; Burrows et al. 2010; Taylor et al. 2004), SEIFA group did not remain significant in either multiple-predictor analysis. Similarly, despite marital status being found to be associated with suicide-related behaviour (Pirkis, Burgess & Dunt 2000; Hawton et al. 2003) and higher education being found to be associated with a lower prevalence of mental health disorders (Andrews, Henderson & Hall 2001) these variables failed to remain significant in either model.

As with suicide ideation, alcohol use failed to remain significant in the multiple-predictor analysis of suicide-related behaviour even though previous studies have found it to be associated (Han et al. 2009; Lopez-Castroman et al. 2011). In both models smoking was positively associated with suicide-related behaviour, a similar finding to Han et al. (2009). The odds ratio was higher in the model using all respondents, perhaps a result of a confounding nature as smokers are likely to report mental health problems in the last year than non-smokers (Australian Bureau of Statistics 2008e).

The majority of the significant variables in both models were related to mental health, supporting the literature where a mental health problem is one of the most significant predictors of suicide-related behaviour (Levinson et al. 2007; Taylor et al. 2004; Zhang et al. 2005; Pirkis, Burgess & Dunt 2000; Beautrais et al. 2006). While those reporting having been diagnosed with depression, anxiety, stress or another mental health problem

in the last year (a current mental health problem) were nine times as likely to report suicide-related behaviour when all respondents were included, this variable failed to remain significant when the sample was limited to only those with suicide ideation. This suggests that this variable differentiates ideation rather than suicide-related behaviours. Unfortunately the current mental health problem variable is likely to be impacted by the definition, where this variable related only to having being diagnosed in the past year and excluded anyone diagnosed more than a year ago but still being treated. In both models the likelihood of reporting suicide-related behaviour increased with increased mental health service use in the last year.

In both models feeling worthless was significantly associated with suicide-related behaviour, supporting Beautrais (2004) findings. In contrast to the suicide ideation model, feelings of hopelessness and depression were not significant. The four week reference period of these questions may account for these differences. The findings that mental health conditions and mental health service use are positively associated with suicide-related behaviour points to the need for people involved in the diagnosis and treatment of these conditions to be monitoring patients and providing strategies for dealing with this type of behaviour.

While physical illness is associated with suicide-related behaviour (Kessler, Borges & Walters 1999; Druss & Pincus 2000; Goodwin, Marusic & Hoven 2003; MacLean et al. 2011), with people reporting ever having asthma or cancer more than four times as likely to report a suicide attempt (Druss & Pincus 2000), these findings were only partially supported by this study. With the exception of a serious injury in the past year no other physical health variables remained significant in either model. Similarly, despite life stressors being found to be associated with suicide-related behaviour Moscicki (1995), only serious injury remained significant in the multiple-predictor analysis of both models.

Being obese remained in the final model that used the sample of ideators, with being obese acting as a protective factor, similar to Batty et al.'s (2010) finding. Interestingly,

BMI was not a significant variable in the multiple-predictor analysis of suicide-related behaviour when all respondents were included, nor in the analysis of suicide ideation.

In the model using all respondents, having a family member who attempted suicide in the last year was significantly associated with suicide-related behaviour, supporting a genetic link for suicidal behaviour (Statham et al. 1998). However, having a friend who attempted suicide was not, which is in contrast to De Leo et al.'s (2005; 2008) findings and to this study's finding regarding suicide ideation. Interestingly, being affected by a friend or family member's serious injury in the last year was significant in both suicide-related models. It is not possible to determine whether those reporting being affected by serious injury would have also been including the family member who attempted suicide in their response. Furthermore, there was also a significant interaction with males and serious injury in the model using all respondents.

The variables that were included in the final models were also assessed with the additional six months of data to determine if they remained significant. None of the variables in the model using only respondents who reported suicide ideation remained significant, but this may be a result of the limited sample size. Among all respondents the only variables that remained significant were having been diagnosed with depression, anxiety, stress or another mental health problem in the last year (a current mental health problem); feeling worthless in the last four weeks; being a current smoker and having a family member who attempted suicide in the last year. All the other variables that were significant in the model building process failed to remain significant. Again, the much smaller sample size may have suffered from not enough power to detect differences. Alternatively, there may be other uncaptured variables that influenced the results. The inability to replicate the findings is a limitation of this study, highlighting the complex nature of suicidology and the difficulties in suicidology research.

Performance of models

The final model of suicide ideation resulted in a sensitivity of 19.7% and a specificity of 99.4%. So, while the model was able to correctly identify the majority of respondents with no suicide ideation it did not perform well in correctly identifying those with ideation, which is the more important of the two for prevention programs. When the model was validated by applying the resulting regression equation to an additional six months of HWSS data collected between July and December 2008 the model correctly predicted no ideation for 2,757 of the 2,783 cases, but correctly predicted only 22 of the 120 cases of suicide ideation. This means that less than one in four respondents with suicide ideation were correctly identified by the model, limiting its usefulness as a tool to predict ideation and pointing to the likely influence of other uncaptured variables.

The final model of suicide-related behaviour using all respondents as the sample resulted in a sensitivity of 10.9% and a specificity of 100%. So, while the model was able to correctly identify respondents with no suicide-related behaviour it did not perform well in correctly identifying those with such behaviour. When the model was validated by applying the resulting regression equation to the additional six months of HWSS data the model correctly predicted no suicide-related behaviour for 2,880 of the 2,906 cases, but failed to correctly predict any cases of suicide-related behaviour, making it inappropriate for predicting suicide-related behaviour.

Similarly, the final model of suicide-related behaviour using only respondents who reported suicide ideation as the sample resulted in a sensitivity of 12.6% and a specificity of 98.1%. So, again while the model was able to correctly identify respondents with no suicide-related behaviour it did not perform well in correctly identifying those with suicide-related behaviour. When the model was validated by applying the resulting regression equation to the additional six months of HWSS data the model correctly predicted no suicide-related behaviour for 101 of the 109 cases (92.7%), but none of the eight suicide-related behaviour, thus reinforcing it as being inappropriate for predicting suicide-related behaviour.

As previously mentioned in section 5.1.4, because the HWSS was collected as a population health based survey rather than having been designed specifically for this study there are numerous issues with the questions that would have limited their usefulness and the associations found with both suicide ideation and suicide-related behaviour over the study period. For example, while the questions regarding suicide ideation and suicide-related behaviour related to the last year many of the mental health questions referred to a four week period, limiting their likelihood of being relevant to the suicide behaviour. Furthermore the current mental health variable only referred to respondents who had been diagnosed in the past year and did not also include those previously diagnosed, but taking medication.

Objective Four:

To determine what proportion of self-reported suicide-related behaviour appear in administrative health data sets

The issues regarding the different time periods and the dynamic nature of the questions in the HWSS do not impact on the comparison of the survey and suicide-related behaviours reported in the administrative data. However, it is not possible to distinguish intent to die versus a cry for help in either data type even though it may have been implied in the question wording on the HWSS.

During the study period there were 165 HWSS respondents who reported having suicide-related behaviour in the past 12 months and an additional 17 who reported being unsure or unable to remember. Interestingly there was no significant difference in the agreement for records to be linked for respondents who did and did not report a suicide-related behaviour. However, those reporting "Don't know" were significantly less likely to agree to the linkage. This finding points to an inherent self selection bias in those who agreed to the linkage and may suggest that these people have higher levels of personal views on privacy of information that led them to not want to share this information, or alternatively may reveal feelings of shame or embarrassment regarding their suicidal behaviour (Wiklander, Samuelsson & Asberg 2003).

Similar results were found regarding the responses to suicide ideation and agreement for linkage. Furthermore, the responses to suicide ideation and suicide-related behaviour did not result in a significant difference in the proportion of successfully linked records among the respondents who had agreed to the linkage. Among the respondents who agreed to the linkage 93.2% of the respondents who reported suicide-related behaviour and all of those who reported "Don't know" were successfully linked.

Unfortunately, the number of respondents lost through lack of agreement to link their records or an unsuccessful linkage reduced an already small sample size for the cohort of those reporting a suicide-related behaviour, down from the original 165 (182 including unsure or not able to remember) to 114 respondents. This reduction in the sample size highlights the need for an informed public regarding what data linkage is, how it is performed and how information is used. The respondents who responded "Don't know" to the suicide-related behaviour were analysed as if they had answered a yes, under the assumption that if they had never had such behaviour, or it was a long-time ago, they would have answered no.

Emergency Department Attendances

Respondents who reported suicide-related behaviour and/or suicide ideation in their HWSS interview were significantly more likely to have an ED presentation for any cause in the year prior to their HWSS interview compared with respondents who reported no suicide-related behaviour and/or suicide ideation. However, it was unfortunately not possible to identify suicide-related behaviours within the ED data. Notably there were differences in the diagnosis information available for the ED presentations, which resulted in three different diagnosis fields and classifications being used, if at all. With the exception of Bunbury Hospital, WA country hospitals do not use EDIS and as a result only provided diagnostic information in broad ICD codes or free text, which did not enable the identification of suicide-related behaviour. Due to the sampling design of the HWSS, the majority of respondents reporting suicide-related behaviour were from non-metropolitan areas (62.3%), which further compounded this issue. Only one-quarter of the ED presentations had an ICD-10 diagnosis code and

nearly one in ten presentations had no information at all regarding the diagnosis. While there was an intent variable on the data the mapping of this was incomplete and 96.3% of the presentations had an "unknown" category on this variable, making it unusable. Similarly, 96.5% of the presentations had an "unknown" category on the external cause variable.

Even when the ED presentations were limited to the presentations of respondents who reported a suicide-related behaviour in the HWSS, the major diagnostic category alone did not provide sufficient information to determine whether the presentations were related to a suicide-related behaviour. While the majority of these presentations did have presenting problem (symptom) information, the completely different classification system of this information meant it was not possible to combine it with the major diagnostic category.

There were 11 presentations with a symptom of "suicidal" or "deliberate self-harm", but as only cases with no major diagnostic category had a symptom, it was not possible to determine what major diagnostic category was used for suicide-related behaviour. These 11 presentations had ICD-10 codes other than intentional self-harm. This may have been consistent with the coding of the hospital admission information, where the external cause of injury code rather than the principal diagnosis identified intentional self harm, but as the external cause of injury was unknown this was not possible to determine.

Only 12 of the 13 respondents with a hospital admission for intentional self-harm had an ED presentation on either the same date or the day before their admission. None of the ED presentations with a symptom of 'suicidal' subsequently appeared as intentional self-harm HMDS admissions. Furthermore, none of the ED presentations with a symptom of 'suicidal' had a MHIS contact date around the same time. This suggests that even though these patients may have appeared suicidal they were not admitted to hospital.

The issues for this study with the coding of the ED information highlight the potential difficulties of using information that was collected for a different purpose, such as administrative information. It also highlights the need for complete and consistent

coding and reporting. In the future WA is moving to WebPAS, which may help alleviate some of the issues caused as a result of multiple systems being used across WA. Unfortunately it was therefore not possible to determine what proportion of respondents who reported suicide-related behaviour presented to an ED. As suicide researchers often use presentations to EDs as a sampling frame (e.g. (Lopez-Castroman et al. 2011; Ozdel et al. 2009; Saiz-Gonzalez et al. 2009; Suominen et al. 2002; Larkin, Smith & Beautrais 2008; Estevens, Carvalho & Tur 2009) the inability to identify suicide attempts was a major limitation of this study and an area that could hopefully be addressed in future studies.

Hospitalisations

Of the 114 respondents who were successfully linked and reported suicide-related behaviour or answered "Don't know", only 8.8% of these respondents (10) had a hospital admission for intentional self-harm in the 12 months prior to their HWSS interview. The respondents admitted to hospital would only comprise a subset of those with suicide-related behaviour as these would have been medically serious behaviours for them to be admitted. Any attempt that did not result in an injury, such as an attempt where someone was physically stopped by another person, or an injury considered not necessary for admission would be reported by the HWSS but not necessarily by the hospital admission data, unless admitted for a mental illness.

Therefore the findings from this study suggest that only 9% of self-reported suicide-related behaviours are admitted to hospital and that for every 10 hospitalisations for suicide-related behaviour there are another 104 that will not appear in the inpatient hospital system. This estimate is similar to Meehan et al.'s (1992) finding where 10% of respondents self reporting suicide-related behaviour reported having been hospitalised, but this was limited to only young adults and relied solely on self-reported measures. Similarly while Crosby, Cheltenham, and Sacks (1999) included all adults in their estimate of 30%, again this relied solely on self-reported measures and Sayer, Stewart and Chipps' (1996) estimate of between 13% and 17% was extrapolated from death data. Hence, by using linked data this study was able to provide an objective measure regarding the hospitalisation of people self reporting suicide-related behaviour and

highlights that studies relying on administrative health records are likely to greatly underestimate the extent of suicide-related behaviour. Unfortunately the sample was not large enough to compare the similarities between those admitted to hospital and those not.

There was no additional information available regarding whether there was any intent to die for these hospital admissions. Hospitalisations that were not coded as intentional self-harm were excluded, which could have resulted in an under-estimate of suicide-related behaviour seen in hospital if these episodes were classified as something else. For example, a single traffic-related injury may have been a suicide-related behaviour, but without sufficient information would not be classified as intentional self harm.

There were more females than males with a linked hospital admission and all the respondents with multiple admissions were female, supporting the literature that females are more likely to be hospitalised for suicide-related behaviour than males (De Leo et al. 2005; Beautrais 2001). It is however, not possible to determine if this gender difference is a reflection of the greater number of females than males reporting suicide-related behaviour in the HWSS or a greater propensity for females to seek help afterwards.

Poisoning was the most common reason for the intentional self harm hospitalisation, in line with intentional self harm hospitalisations in WA, where poisoning accounted for 81.8% of all hospitalisations between 2007 and 2011 (Department of Health Epidemiology Branch & Cooperative Research Centre for Spatial Information (CRC-SI) 2012c). This finding was in contrast to the most common method of suicide in Australia, where hangings accounted for more than half the suicides from 2006 (Goldney 2006; Australian Bureau of Statistics 2008b) to 2010 (Australian Bureau of Statistics 2012l). As there is conflicting evidence as to the association between intent and method chosen for suicide attempts (Haw et al. 2003; Harriss, Hawton & Zahl 2005; Hjelmeland 1996b) it is not possible to infer whether there were additional hospitalisations for suicide-related behaviour that were not regarded as such.

An additional less than five[13] respondents reported no suicide-related behaviour or suicide ideation in the HWSS, but had a linked hospital admission for intentional self harm in the 12 months prior to their HWSS interview. There is a possibility that this contradiction may be due to a recall of either the event (perhaps as an adaptive mechanism (Robert et al. 2009)) or the time frame, but as one of these admissions was around six weeks prior to the HWSS interview this seems unlikely. Respondents may have reported no suicide-related behaviour in their HWSS interview because they had not intended to take their own life when they were admitted to hospital. Alternatively, it may be that respondents were answering the HWSS in a socially desirable manner or that the respondents lied in their HWSS interview due to embarrassment or shame at either having made the attempt in the first place or having made the attempt and surviving (Wiklander, Samuelsson & Asberg 2003).

Mental Health

While nearly all the HWSS respondents (99.6%) who reported no mental health service usage in the past year had no corresponding MHIS records, there were also no MHIS records for the majority of respondents (80.8%) who reported having used such services. Of the 114 responses with a suicide-related behaviour in the HWSS only 29 (25.4%) had a MHIS record in the year prior to their interview. These findings are however, limited because the MHIS is only completed by public service providers, so private mental health providers, such as private psychologists and counsellors are not included in the MHIS. The usefulness of the MHIS data in this study is also further limited by the multiple contacts entered into the system for the same client. For example, a client who is seen by multiple health workers during the same treatment session would have multiple contacts recorded. This may explain why nearly two-thirds of respondents with MHIS records had more MHIS contacts than self-reported in the HWSS.

Overall

The lack of a hospital admission record or an ED presentation for the respondents who reported a suicide-related behaviour does not necessarily mean that they did not seek

[13] Cases with fewer than five have not been reported to ensure confidentiality, as per DoH guidelines.

medical help. Respondents reporting suicide-related behaviour may have visited a general practitioner or a private mental health worker, who were out of scope of this study. Furthermore the linked data related only to WA records, so there is the possibility that respondents may have presented to an ED or were admitted to hospital in another state. During the study period, WA experienced a period of population growth, which was due in part to the resources boom experienced by the state. WA was one of only two states to report a net increase in interstate migration for each year from 2003 onwards (Australian Bureau of Statistics 2012k). As there was no information collected by the HWSS as to how long respondents had been in the state it was not possible to determine the impact of this possibility. Future studies could investigate the agreement between self-reported suicide-related behaviour and visits to general practitioners and/or presentations and admissions to hospitals in any state in Australia.

Irrespective of the reasoning, there is a great disparity between information collected from surveys such as the HWSS and information collected from administrative data sets. While administrative data sets provide a wealth of readily available information, the usefulness of this information will not always be appropriate for research studies. Studies selecting respondents based on administrative data or responses to a survey need to bear this in mind as they are likely to be two different groups.

Objective Five and Six:

To determine what proportion of people (including non suicide ideators as well as those engaging in suicide ideation and suicide-related behaviour) subsequently died during the study period as a result of suicide

Two percent (515) of the 22,666 HWSS respondents with a successful linkage subsequently died in Australia (prior to February 2009). Of the 515, only 3.7% had reported suicide ideation and less than 1% had reported suicide-related behaviour during their HWSS interview. There was no significant difference in the suicide ideation and suicide-related behaviour in the proportion of respondents who subsequently died. Similarly, neither suicide ideation nor suicide-related behaviour was significantly

associated with survival time in a Cox proportional hazards regression. These finding are in contrast to previous studies that have found that people with suicide-related behaviour are more likely to die from any cause than those with no suicide-related behaviour (Holley, Fick & Love 1998a; Lawrence et al. 2000; Lawrence et al. 2001; Ostamo & Lönnqvist 2001; Suominen, Isometsa, Ostamo, et al. 2004; Holley, Fick & Love 1998b). The short follow-up period in this study may account for some of this difference and limits these findings.

Due to the delay in obtaining coded death information, only the deaths registered in 2006 or earlier (38.6%) had coded information. As a result, cause of death text was used to categorise deaths as intentional self harm. There were fewer than five[14] respondents who appeared in the hospital admission information with an intentional self-harm record and subsequently died, but these death(s) were not possible suicides. Deaths that were classified by a coroner as deliberately self inflicted were regarded as a suicide. Using these classifications there were seven suicides and 15 deaths awaiting a coronial inquiry, that were regarded as possible suicides. Less than five of these 22 had reported suicide ideation in their HWSS interview.

The average duration between HWSS interview and these 22 deaths was more than two and a half years, so there may have been suicidal thoughts and behaviour and/or major life events during this time period that were not captured by this study. These findings highlight the transient nature of suicidal behaviour and that suicide is not necessarily inevitable for someone experiencing suicide ideation and/or suicidal behaviour. However, the different durations of follow-up time are a limitation of this study.

[14] Cases with fewer than five have not been reported to ensure confidentiality, as per DoH guidelines.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The aim of this study was to add to the body of information regarding suicide behaviour using a population health survey linked with administrative data sets. In particular, as one known limitation of self-reported information is that it has not been validated against objective information (Borges et al. 2006; Pirkis, Burgess & Dunt 2000), this study sought to objectively validate self-reported suicide-related behaviour. The findings from this study suggest that only 9% of self-reported suicide-related behaviours are admitted to hospital, highlighting that studies relying on administrative health records will greatly underestimate the extent of suicide-related behaviour.

As with other studies, while many significant associates of suicidal behaviour were found the discriminative ability of these variables was limited as all of these models offered poor sensitivity. Mental health variables, including mental health service use, were the greatest predictors of suicide ideation and suicide-related behaviour. This finding underscores the need for mental health workers and services to remain mindful of suicidal behaviour, particularly as almost half (45%) of Australian 16 to 85 year olds have reported having experienced a mental disorder at some point during their lives (Australian Bureau of Statistics 2008d).

Within Australia there has been an increase in the recognition and prominence of mental health issues in Australia over the last few years. The continuation of this and public education programs that decrease the stigma of mental disorders and improve the recognition of both mental disorders and risk of suicide behaviour is vital.

As far as the author is aware this study was the first time the HWSS had been linked with administrative health data sets. While this study did provide information regarding

suicide ideation and suicide-related behaviour, perhaps its greatest contribution is in identifying the shortcomings of using linked data sets for this purpose.

Whereas the linked administrative data sets do not suffer from the potential for self selection bias as they do not require consent for data linkage, this was not the case for the HWSS where only 77% of respondents to the HWSS agreed for their data to be linked. This finding highlights the potential for a systematic self selection bias if the linkage of non-administrative data, such as population health surveys, were to be used for research and surveillance purposes. Ensuring respondents understand the benefit of linked data, how it will be used, what it will be linked to and how their privacy will be maintained will be paramount to increase the likelihood of agreement to linkage. Furthermore, it may be necessary to adjust any future linked non-administrative data to take into account the inherent bias.

The methodology of the data linkage may also impact on the success of the linkage. In WA the linkage is achieved using probabilistic matching (Holman et al. 2008), and so ensuring that names and date of birth are accurately recorded when linkage consent is given will increase the success of the linkage.

While the core data sets in WA are covered by legislation ensuring they are not only provided, but provided in a standard format (Holman et al. 1999), inconsistencies in coding and incomplete variables in one of these core data sets greatly limited the usefulness of the information within this study. In particular, the external cause and intent variables within the ED data were unknown for the vast majority of the cases, making it impossible to identify suicide-related behaviour. These findings highlight the need for consistent and complete coding practices across different hospitals/services as well as over time. Educating both clinical and clerical staff who complete the administrative data as to why these variables exist and how they may be used may help to ensure the completeness of the data.

6.2. Recommendations

This study resulted in eleven recommendations across three broad areas, which are outlined below.

Administrative data sets and linkage

1. If possible ED data should include information, such as intent and external cause of injury, that will make it possible to identify presentations for suicide-related behaviour. Including this information would make the data useable for suicide research purposes, but perhaps more importantly may be helpful to clinicians, particularly in instances where multiple clinicians are involved, as well as in clinical reviews.
2. Jurisdictions should use consistent and complete coding and reporting of administrative data. In the future this will hopefully be achieved in WA with the move to WebPAS.
3. Studies using self-reported information linked to other data sets should take into account the inherent self selection bias resulting from the agreement to link data. The findings from this study will help inform this adjustment.
4. To maximise agreement for data linkage researchers should ensure the public is well informed about what data linkage is, how it is performed, what data sets are linked and how their information will be used.

Suicide research

5. As suggested in previous studies, the use of consistent terminology in suicide research will enable the direct comparison of results and a greater focus on where future research is needed.
6. Studies that rely on administrative health records will need to be mindful of the large underestimate of suicide-related behaviour from such data sources (less than one in ten self-reported suicide-related behaviours are admitted to hospital).

Suicide prevention

7. The associates of suicide ideation and suicide-related behaviour found by this study should be taken into account by both health professionals and policy makers.
8. As the discriminative ability of suicide ideation and suicide-related behaviour remains limited, suicide prevention strategies need to continue to have a public health focus including educating the community regarding the recognition and risk of both mental health and suicide-related behaviour, and what to do if someone is experiencing such issues.
9. General health professionals should be aware that around one in 20 adults self-reported suicide ideation in the last year and consider general contacts with patients as an opportunity for screening and/or intervention.
10. Health professionals should continue to be educated about the recognition of mental health issues and suicidal behaviour, and associated treatments/interventions.
11. Mental health variables including mental health service use were the greatest predictors of suicide ideation and suicide-related behaviour. Hence, mental health services and mental health professionals in particular should use contacts with patients as opportunities to identify and discuss suicide-related behaviour and strategies.

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8. APPENDIX A – HWSS Questions included in this study

GEN1 In general, how would you say your health is:
(Read options. Single response)
1. Excellent
2. Very good
3. Good
4. Fair
5. Poor
997 Refused

GEN2 Overall, how would you rate your health during the past 4 weeks?
(Read options. Single response)
1. Excellent
2. Very good
3. Good
4. Fair
5. Poor
6. Very poor

GEN3 During the past 4 weeks, how much did physical health problems limit your usual physical activities (such as walking or climbing stairs)?
(Read Options. Single Response)
1. Not at all
2. Very little
3. Somewhat
4. Quite a lot
5. Could not do physical activities

GEN4 During the past 4 weeks, how much difficulty did you have doing your daily work, both at home and away from home, because of your physical health?
(Read Options. Single Response)
1. None at all
2. A little bit
3. Some
4. Quite a lot
5. Could not do daily work

GEN5 How much bodily pain have you had during the past 4 weeks?
(Read Options. Single Response)
1. None
2. Very mild
3. Mild
4. Moderate
5. Severe
6. Very severe

GEN6 During the past 4 weeks, how much energy did you have?
(Read Options. Single Response)
1. Very much
2. Quite a lot
3. Some
4. A little
5. None

GEN7 During the past 4 weeks, how much did your physical health or emotional problems limit your usual social activities with family or friends?
(Read Options. Single Response)
1. Not at all
2. Very little
3. Somewhat
4. Quite a lot
5. Could not do social activities

GEN8 During the past 4 weeks, how much have you been bothered by emotional problems (such as feeling anxious, depressed or irritable)?
(Read Options. Single Response)
1. Not at all
2. Slightly
3. Moderately
4. Quite a lot
5. Extremely

GEN9 During the past 4 weeks, how much did personal or emotional problems keep you from doing your usual work, school or other daily activities?
(Read Options. Single Response)
1. Not at all
2. Very little
3. Somewhat
4. Quite a lot

GEN11a Do you or does anyone in your family have any disability, long term illness or pain that puts a burden on you or the family as a whole?
(Single Response. Code Unsure/Don't Know/Can't remember as 998 and Refused as 999)
0 No
1 Yes, me
2 Yes, other member of my family
998 Unsure/Don't know/Can't remember
999 Refused

Chronic Conditions:

Has a doctor ever told you that you have:
(READ OPTIONS)

COM6 Arthritis
(Single Response)
0 No
1 Yes
998 Unsure/Don't know/Can't remember
999 Refused

COM7 Heart disease
(Single Response)
0 No
1 Yes
998 Unsure/Don't know/Can't remember
999 Refused

COM8 Stroke
(Single Response)
0 No
1 Yes
998 Unsure/Don't know/Can't remember
999 Refused

COM9A Excluding skin cancer, any other form of cancer
(Single Response)
0 No
1 Yes
998 Unsure/Don't know/Can't remember
999 Refused

COM21 Has a doctor ever told you that you had diabetes?
(Single Response)
0 No
1 Yes
998 Unsure/Don't Know/Can't remember.
999 Refused

How many times in the past 12 months, have you used these health services?
(Code None as 0, Unsure/Don't know/Can't remember as 998 and Refused as 999)

SER1 Primary health services e.g. medical specialist, general practitioner, community health centre, community or district nurses
Enter number _____

SER5 A mental health service e.g. psychiatrist, psychologist or counsellor
Enter number _____

The next questions are about how you have been feeling in the past 4 weeks.
(Interviewer note: The following 10 questions are part of the K10, a standardised instrument that measures psychological distress. It is different from the SF8, which asks about physical as well as mental functioning. If asked, please use this explanation to let respondents know that even though some of the questions in the K10 and SF8 are similar, they are actually used to measure different things)

KES1 In the past four weeks, about how often did you feel tired out for no good reason?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

KES2 In the past four weeks, about how often did you feel nervous?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time **Go to KES4**

KES3 In the past four weeks, about how often did you feel so nervous that nothing could calm you down?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

KES4 In the past four weeks, about how often did you feel hopeless?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

KES5 In the past four weeks, about how often did you feel restless or fidgety?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time **Go to KES7**

KES6 In the past four weeks, about how often did you feel so restless you could not sit still?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

KES7 In the past four weeks, about how often did you feel depressed?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

KES8 In the past four weeks, about how often did you feel everything was an effort?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

KES9 In the past four weeks, about how often did you feel so sad that nothing could cheer you up?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

KES10 In the past four weeks, about how often did you feel worthless?
(Read Options. Single Response)
1. All of the time
2. Most of the time
3. Some of the time
4. A little of the time
5. None of the time

BOD1 What is your height without shoes?
(Single Response. Code Unsure/Don't Know/Can't remember as 998 and Refused as 999 in FIRST field.)
Centimetres ___
OR
Feet ___ Inches ___

BOD2 How much do you weigh without clothes or shoes?
(Single Response. Code Unsure/Don't Know/Can't remember as 998 and Refused as 999 in FIRST field.)
Kilograms (Kg) ____
OR
Stones ____ Pounds ____

ALC1 How often do you usually drink alcohol?
(Single Response. Code Do not drink as 0 and go to NEXT MODULE. Code Unsure/Don't know/Can't remember as 998 and Refused as 999 and less than once a week as 991)
Number of days _____

ALC2 A Standard Drink is equivalent to a schooner or midi of full strength beer, a glass of wine or a nip of spirits. On a day when you drink alcohol, how many standard drinks do you usually have?
(Single Response. Code Unsure/Don't know/Can't remember as 998 & Refused as 999.)
Number of drinks ____

The following questions are about tobacco smoking. This includes cigarettes, cigars and pipes.

SMO2 Which of the following best describes your smoking status?
(Single Response. Read options)
1. I smoke daily **Go to NUT1**
2. I smoke occasionally **Go to NUT1**
3. I don't smoke now but I used to
4. I've tried it a few times but never smoked regularly
5. I've never smoked **Go to NUT1**
998. Unsure/Don't know/Can't remember **Go to NUT1**
999 Refused **Go to NUT1**

SMO2a Over your lifetime, would you have smoked at least 100 cigarettes or a similar amount of tobacco?
(Single Response. Read options)
0. No
1. Yes
998. Unsure/Don't know/Can't remember
999 Refused

The next questions are about your social and emotional wellbeing.

PERCEIVED LACK OF CONTROL (Module LAC)
LAC1 During the past four weeks how much of the time did you feel a lack of control over your life in general:
(Read options. Single response)
1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
998 Unsure/Don't know/Can't remember
999 Refused

LAC3 During the past four weeks how much of the time did you feel a lack of control over your personal life:
(Read options. Single response)
1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
998 Unsure/Don't know/Can't remember

LAC6 During the past four weeks how much of the time did you feel a lack of control over your health:
(Read options. Single response)
1. Never
2. Rarely
3. Sometimes
4. Often
5. Always
998 Unsure/Don't know/Can't remember
999 Refused

These questions relate to events that have either happened directly to the respondent or have happened to other people but have had an effect on the respondent
In the past 12 months how many times have you personally been affected by any of the following?
(Code never as 0)
PSE1 Moved house Number of times _____
PSE2 Robbed or home burgled Number of times _____
PSE3 Death of somebody close to you Number of times _____
PSE4 Marriage/relationship breakdown Number of times _____

PSE5 Serious injury Number of times _____
PSE6 Serious illness Number of times _____
PSE7 Loss of driver's license Number of times _____
PSE8 Financial hardship Number of times _____
PSE9 Any other major event Number of times _____

MEN1 In the last 12 months have you been told by a doctor that you had an anxiety problem?
(Single Response)
0 No
1 Yes
998 Unsure/Don't Know /Can't remember
999 Refused

MEN2 In the last 12 months have you been told by a doctor that you are depressed?
(Single Response)
0 No
1 Yes
998 Unsure/Don't Know /Can't remember
999 Refused

MEN3 In the last 12 months have you been told by a doctor that you had a stress-related problem
(Single Response)
0 No
1 Yes
998 Unsure/Don't Know /Can't remember
999 Refused

MEN4 In the last 12 months have you been told by a doctor that you had any other mental health problem
(Single Response)
0 No
1 Yes
998 Unsure/Don't Know /Can't remember
999 Refused

A yes response to any of MEN1 to MEN4 was coded as a current mental health problem.

CAP1 How many groups/associations do you belong to? Include church groups, social groups, sporting groups, political groups, professional groups etc…
Enter number _____

DEM1 What was your age last birthday?
Enter age_____

RECORD THE SEX
DEM5 Sex (DO NOT ASK. If unsure at end of interview, delete interview)

CHA2 Are you of Aboriginal or Torres Strait Islander origin?
(Single Response)
0 No
1 Yes, Aboriginal
2 Yes, TSI
3 Yes, both Aboriginal and TSI
998 Unsure/Don't know/Can't remember
999 Refused

CHA26 What is the highest level of primary or high school that you have completed?
(Single Response. *Interviewer note: Prompt if necessary)*
1. Never attended school
2. Currently still at school
3. Year 8 or below
4. Year 9 or equivalent
5. Year 10 or equivalent
6. Year 11 or equivalent
7. Year 12 or equivalent (matriculation/leaving)
998 Unsure/Don't Know/Can't Remember
999 Refused

CHA27 Have you completed any qualifications (since leaving school)?
(Single Response. *Interviewer note: Prompt if necessary)*
0. No **Go to CHA7**
1. Yes **Go to CHA28**
998 Unsure/Don't know/Can't remember
999 Refused

CHA28 What is the highest qualification you have completed?
(Single Response. *Interviewer note: Prompt if necessary)*
1. Bachelor degree or higher
2. Diploma or certificate taking more than 12 months full time
3. Diploma or certificate taking less than 12 months full time
4. Trade / apprenticeship
998 Unsure/Don't know/Can't remember
999 Refused

CHA7 Which ONE of the following best describes your current employment status? Are you:
(Single Response. Read options. Interviewer note: This question relates to MAIN occupation. A full-time student who works part-time is coded as a student)
1. Self employed
2. Employed for wages, salary or payment-in-kind
3. Unemployed for less than one year
4. Unemployed for more than one year
5. Engaged in home duties
6. Retired
7. Unable to work
8. A student
9. Other
998 Unsure/Don't Know/Can't Remember
999 Refused

CHA14 What best describes your current living arrangements?
(Read Options. Single Response)
1. Living with my parent(s)
2. Living with other family members
3. Living with friends
4. Living with a partner and children
5. Living with a partner but no children
6. Living alone
7. Living in a nursing home
8. Living in a retirement village
9. Other living arrangements
998 Unsure/Don't Know/Can't Remember
999 Refused

CHA15 What is your marital status?
(Read Options. Single Response)
1. Married
2. Living with a partner/Defacto
3. Widowed
4. Divorced
5. Separated
6. Never Married
998 Unsure/Don't Know/Can't Remember
999 Refused

CHA17 Which best describes your household money situation?
(Read Options. Single Response)
1. I am / we are spending more money than I / we get
2. I / we have just enough money to get us through to the next pay day
3. There's some money left over but I / we just spend it
4. I / we can save a bit every now and then
5. I / we can save regularly
6. I / we can save a lot
998 Unsure/Don't know/Can't remember
999 Refused

CHA18 I would now like to ask you about your household's income. We are interested in how income relates to health, lifestyle and access to health services. Before tax is taken out, which of the following ranges best describes your household's income, from all sources, over the past 12 months?
(Read Options. Single Response)
1. Under $20,000
2. $20,000 - $40,000
3. $40,000 - $60,000
4. $60,000 - $80,000
5. $80,000 - $100,000
6. More than $100,000
998 Unsure/Don't Know/Can't Remember
999 Refused

WEI6 What is your postcode?
(Single Response)
Enter postcode _____

WEI7 What is your suburb, town or community?
(Single Response. Leave Blank if refused)
Enter town /suburb _____

And finally, we have some personal questions. These may seem a little intrusive, but as they relate to problem areas in Australia we would like to ask you these questions. As with the rest of the survey, you may refuse to answer these questions if you wish. If you find the questions distressing and would like to talk with someone, we will be giving you a number that you can call.

SUI1 Sometimes, people feel really down and so depressed they feel they can't cope anymore. Sometimes they might think about hurting themselves or even killing themselves. During the past 12 months have you ever seriously thought about ending your own life?
(Single Response)
0 No **Go to SUI3**
1 Yes
998 Unsure/Don't Know/Can't Remember **Go to SUI3**
999 Refused **Go to SUI3**

SUI2 In the past 12 months have you tried to end your own life?
(Single Response)
0 No
1 Yes
998 Unsure/Don't know/Can't remember
999 Refused

SUI3 In the past 12 months have any of your friends tried to end their own lives?
(Single Response)
0 No
1 Yes
998 Unsure/Don't know/Can't remember
999 Refused

SUI4 In the past 12 months, have *any of your family* tried to end their own lives?
(Single Response)
0 No
1 Yes
998 Unsure/Don't know/Can't remember
999 Refused

LIN2 And finally, as you know the Department of Health collects information on things like hospital visits and births etc. We would like your permission to link the information from this survey with some of the health information the Department of Health has about you, such as hospital visits. The information will be put together into a report about all adults in WA and you will never be identified individually.

(Single Response)

0 No **(If permission is denied, thank the respondent and terminate the interview.)**

1 Yes **(If response is Yes, record full name and date of birth.)**

Enter first name _____

Enter surname _____

Enter date of birth _____

Enter street number _____

Enter street name _____

(Interviewer note: If asked by respondents, the health information provided by the survey is linked to the hospital data and other health information, but individuals per se are not identified. We are only interested in patterns of health behaviours and we never identify individuals. The respondent's confidentiality is respected at all times.

9. APPENDIX B – Regression equations to predict suicide-related behaviour

To determine the predictive ability of each of the logistic regression models the regression coefficients were used to create an equation that was then applied to the June to December 2008 data. These equations are shown below.

A. Equation for suicide ideation

ideatelogit = -5.2893 -0.0487*kimpilb -0.0691*metro -0.00918*apr +0.093*aug -0.2922*dec -0.1294*feb +0.0425*jan +0.0332*july +0.0641*june -0.0401*mar -0.1094*may +0.1404*nov -0.0218*oct -0.1852*sex +0.9136*adult1624 +0.3307*adult2544 +0.3241*adult4564 +0.8271*currmhp +0.7393*k4allmost +0.4487*k4some +0.3752*k4little +1.5266*k7all +1.4487*k7most +1.3415*k7some +0.8717*k7little +1.0466*k10allmost +0.7215*k10some +0.63*k10little +0.9451*mentalgrp3 +0.7307*mentalgrp2 +0.2792*mentalgrp1 +0.1502*stress1 +0.3961*stress2 +0.5559*stress3 +0.7695*lackgenall +0.6887*lackgenoft +0.6237*lackgensome +0.2749*lackgenrare -0.126*livepar -0.3862*livefamfri -0.6488*livepartkid -0.4102*livepartnokid -0.2973*liveoth +0.3708*lackhlthaloft +0.2789*lackhlthsome +0.1966*lackhlthrare +0.4409*palscide +0.2432*disable

B. Equation for suicide-related behaviour (applied to all respondents)

Model five

attemptlogit = 260.7 +0.301*kimpilb +0.0238*metro -0.134*year -1.385*apr -0.097*aug -0.631*dec +0.1357*feb +0.0026*jan -0.936*july +0.6809*june -0.081*mar -1.068*may -1.260*nov -0.232*oct +1.2273*sex +2.00915*adult1624 +0.0925*adult2544 -0.195*adult4564 +2.203*currmhp +2.2167*k10allmost +1.8488*k10some +0.9487*k10little+2.1946*mentalgrp3 +0.9225*mentalgrp2 -0.503*mentalgrp1 +2.5535*injured +1.0231*smokes +1.2681*famscide +0.1048*feminj +2.5537*maleinj

Model three

attemptlogit = 46.551 +0.2922*kimpilb -0.175*metro -0.027*year -0.027*apr +0.1588*aug -0.253*dec +0.4255*feb -0.858*jan -0.858*july +0.6723*june +0.2918*mar -0.0664*may -0.209*nov +0.6163*oct +0.0764*sex +1.6355*adult1624+0.1774*adult2544 +0.0948*adult4564 +0.9558*currmhp -0.868*obese -0.589*overweight +1.9591*k7all + 1.4766*k7most+1.5207*k7some + 1.2278*k7little +2.1346*k10allmost +1.3916*k10some +0.4463*k10little +2.2789*mentalgrp3 +1.1713*mentalgrp2 -0.00085*mentalgrp1 +0.7985*injured +0.1402*stress1 +0.8296*stress2+0.5024*smokes

C. Equation for suicide-related behaviour (applied to respondents with ideation only)

attemptlogit = 26.446 +0.2765*kimpilb -0.025*metro -0.015*year +0.1003*apr +0.2996*aug -0.001*dec +0.291*feb +0.0677*jan -0.624*july +0.9198*june +0.4708*mar -0.558*may +0.0006*nov +0.899*oct +0.323*sex +0.9088*adult1624 +0.1313*adult2544 -0.131*adult4564 -0.957*obese -0.428*overweight +2.2093*mentalgrp3 +0.8268*mentalgrp2 -0.019*mentalgrp1 +1.0435*injured +1.1026*k10allmost +0.7062*k10some -0.244*k10little

10. APPENDIX C – Logistic regression results of suicide-related behaviour (model three)

The variables from the HWSS were used in a logistic regression to explore their ability to predict suicide-related behaviour. As the model discussed in the results section (model five) included a variable that restricted responses to only those collected from 2006 onwards, model three, which used responses from all the years, is shown below.

Table C. 29 Single-predictor and multiple-predictor (model three) odds ratios of suicide-related behaviour (all respondents)

	Single-predictor (adjusted for year, month and geographic area)		Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI	OR	95% CI
Female	1.7 **	(1.2 - 2.4)	1.1	(0.7 - 1.7)
Age (ref = 65+)				
16-24 yrs	10.1 ^	(5.3 - 19.3)	5.1 **	(2.1 - 12.3)
25-44 yrs	3.2 **	(1.7 - 6.3)	1.2	(0.5 - 3.0)
45-64 yrs	2.1 *	(1.1 - 4.1)	1.1	(0.5 - 2.7)
Current mental health problem	18.2 ^	(12.8 - 26.0)	2.6 **	(1.4 - 4.7)
BMI category (ref = not overweight or obese)				
Obese	0.6	(0.4 - 1.0)	0.4 **	(0.2 - 0.8)
Overweight	0.5 **	(0.3 - 0.7)	0.6 *	(0.3 - 1.0)
Felt depressed in last 4 weeks (ref = none of the time)				
All of the time	159.4 ^	(90.6 - 280.7)	7.1 **	(2.4 - 21.2)
Most of the time	69.6 ^	(41.0 - 118.2)	4.4 **	(1.6 - 12.0)
Some of the time	15.3 ^	(9.0 - 26.0)	4.6 **	(1.9 - 10.9)
A little of the time	5.4 ^	(3.1 - 9.4)	3.4 **	(1.5 - 7.7)
Felt worthless in last 4 weeks (ref = none of the time)				
All/most of the time	70.3 ^	(46.1 - 107.1)	8.5 ^	(3.8 - 18.7)
Some of the time	22.6 ^	(14.7 - 34.8)	4.0 ^	(2.0 - 8.0)
A little of the time	9.5 ^	(6.0 - 15.2)	1.6	(0.7 - 3.3)
Mental health service use (ref= no use)				
13 or more times	72.8 ^	(45.1 - 117.7)	9.8 ^	(4.7 - 20.2)
2 to 12 times	17.6 ^	(12.0 - 26.0)	3.2 ^	(1.8 - 5.8)
1 time	7.7 ^	(3.5 - 16.9)	1.0	(0.3 - 3.5)

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)

Table C. 29 Single-predictor and multiple-predictor (model three) odds ratios of suicide-related behaviour (all respondents) continued

	Single-predictor (adjusted for year, month and geographic area)		Multiple-predictor (adjusted for year, month and geographic	
	OR	95% CI	OR	95% CI
Number of different types of stressors (ref = no stressors)				
2 or more	15.1 ^	(8.4 - 26.9)	2.3 *	(1.1 - 4.8)
1	3.0 **	(1.6 - 5.8)	1.2	(0.5 - 2.7)
Smokes (ref = non-smokers)	3.4 ^	(2.5 - 4.6)	1.7 *	(1.0 - 2.6)
Life stressors in last year (ref = no)				
Serious injury	5.5 ^	(3.7 - 8.3)	2.2 **	(1.3 - 3.8)
Serious illness	4.0 ^	(2.7 - 5.7)	-	- -

*p<.05 (Chi square) **p<.01 (Chi square) ^p<.0001 (Chi square)